

THE SCIENCE TEACHER

VOLUME 28, NUMBER 4 • MAY 1961





HOW CLOSE ARE WE TO TEACHING MACHINES IN THE CLASSROOM?

**A Special Report on TMI-GROLIER Programmed Courses,
Programmed Texts and Low-Cost Teaching Machines**

THE DEVELOPMENT of programmed learning has progressed to the point where teachers and educators everywhere are asking how this new instructional method will affect them, their schools, and their classes.

TMI-GROLIER, a pioneer in programming research and teaching machines, has been engaged in extensive experimentation and testing, under the leadership of a team of educators and psychologists headed by Dr. Lloyd E. Homme and Dr. James L. Evans.

Working closely with other psychologists in the field, and drawing on the best practical and theoretical experience available, TMI-GROLIER has produced a series of programmed courses and texts. In addition, we have perfected and are manufacturing the first practical low-cost teaching machine for use with programmed courses.

The TMI-GROLIER programmed courses and texts include spelling, arithmetic, algebra, punctuation, music; basic courses in Spanish, French, German, Latin and Russian, and others. Every course has been extensively tested, together with the TMI-GROLIER teaching machine, in actual classrooms, such as the Albuquerque classroom pictured above.

Feedback data are incorporated in the final revisions of every course.

"Teaching machines, properly programmed and properly used, are our best hope for education."

This statement, made by Professor James McClellan of Teachers College, Columbia University, perfectly summarizes the aspirations of TMI-GROLIER.

We do not pretend to know all the answers to programmed learning. However, with the cooperation of leading educators, curriculum specialists, and psychologists, we have successfully completed the first necessary steps of this great educational experiment: we have produced a series of thoroughly tested programmed courses and texts; we are now manufacturing in quantity the first practical teaching machines for those educators who want to test them.

Our next step is clearly one in which TMI-GROLIER must explore, together with the educators in the nation's schools, the best possible means for utilizing the courses and

machines we now have, and others which are in preparation.

Together, we will find the answers to many questions: In what aspects of learning can teaching machines be of optimum use? How effective are they in the classroom? For the individual student? For the teacher? To what extent should school administrators and boards of education consider teaching machines and programmed learning?

In this second phase of development, TMI-GROLIER is now at work, correlating our findings with those of others in the educational world. Our courses are constantly being revised and re-designed to meet the actual needs of the teacher and classroom. Our full-scale Programming Facilities are coordinated with the mainstream of leading educational thinking. In short, today's classroom needs are determining the direction of TMI-GROLIER's expanding services in the field of programmed learning.

If you wish to know more about TMI-GROLIER's low-cost teaching machines and programmed courses, and how you can efficiently test and evaluate them, simply write on your school letterhead to Dept. 14

TEACHING MATERIALS CORPORATION
575 Lexington Avenue, New York 22, N.Y.

A Division of **GROLIER INCORPORATED**
Publishers of The Book of Knowledge and The Encyclopedia Americana

Nalgene laboratory ware does almost everything glass can do...except break

Ever seen a glass lab vessel shatter? Imagine it full of H_2SO_4 ! Some of it splashes on one of your student's hands or clothes.

No matter who is to blame, it's nerve-racking for you. With unbreakable Nalgene lab ware this can't happen.

No flying slivers. No acid splash. No personal injury or property damage. Your full attention can be devoted to lab instruction.

There's a big saving for your equipment budget, too, with Nalgene.

New Nalge techniques keep meeting lab needs to an extent never before possible in plastic.

See the results in this new catalog of corrosion-resistant lab ware.

Everything from pipets to carboys; test tube racks to Buchner funnels.

Just mail the coupon. And check with your laboratory supply dealer.



THE NALGE CO., INC.
ROCHESTER 2, NEW YORK

The Quality Standard of Plastic Laboratory Ware

THE NALGE CO., INC.

Dept. 235, 75 Panorama Creek Drive,
Rochester 2, N. Y.

Please send me your new catalog of Nalgene laboratory ware.

NAME.....

SCHOOL.....

STREET.....

CITY..... ZONE..... STATE.....



Simplifies the Teaching of Radioactivity

"CLASSMASTER" RADIOACTIVITY DEMONSTRATOR

For Showing The Basic Principles of Radioactivity
Suitable For Lecture Demonstrations And For Student Experiments
Perfectly Safe For Inexperienced Operators

Electronic demonstrator provides meter, flashing light, and speaker indication of counts, as well as high voltage supply.

Set of cylinders to illustrate "scatter" produced by beta radiation.



No. 2156

2156. RADIOACTIVITY DEMONSTRATOR, "Classmaster." The teaching of basic principles of radioactivity has been greatly simplified by the use of this demonstrator and it is probable that every progressive high school and college will eventually have such equipment. It is equally effective for class demonstrations by the teacher and for laboratory experiments by the students. There are elementary experiments to stimulate the interest of beginners and more involved procedures to challenge the advanced students.

The equipment consists principally of a sensitive Geiger tube connected to a high voltage supply and amplifier which provides triple indication of radioactivity: by pulses from a loudspeaker, by flashing light, and by a built-in count-rate meter. Various accessories, including two radioactive sources, are furnished. It is safe in every respect. The procedures are straightforward and are clearly presented in the detailed instruction booklet.

Radiation Intensity is measured by the number of counts per minute. *Absorption* of beta and gamma radiation and the effectiveness of various media in this respect can be demonstrated. *Health Hazards* involved in using radioactive materials may be shown with safety by absorption of radiation in a student's hand. *Scattering* of beta radiation and its dependence upon atomic weight can be demonstrated. *Coincidence Loss* due to dead time of the counter when two counts occur close together is shown by measuring the response speed. *Geometry* of the counter, that is, the dependence of response upon the construction and position of the tube, can be determined. *Detection Efficiency*, which depends upon gamma radiation producing beta particles by secondary emission, can be measured.

The apparatus is furnished complete as described and ready for use. It operates on 115 volts, 50 or 60 cycle A.C.

Each \$194.50

THE WELCH SCIENTIFIC COMPANY

— ESTABLISHED 1880 —

1515 SEDGWICK STREET, DEPT. T. CHICAGO 10, ILLINOIS, U.S.A.

Manufacturers of Scientific Instruments and Laboratory Apparatus

THE SCIENCE TEACHER

EDITORIAL DIRECTOR
ROBERT H. CARLETON

EditorFRANCES J. LANER
Staff Assistant.....PHYLLIS R. MARCUCCIO
Advertising and
CirculationGEORGE A. CROSBY
Memberships
and Subscriptions.....EDITH M. LANGLEY

ADVISORY BOARD

ALFRED B. BUTLER (1961) *Chairman*
Washington State University, Pullman,
Washington
MILDRED EINZIG (1961)
Cleveland Public Schools, Cleveland,
Ohio
ALAN MANDELL (1963)
Norfolk County Public Schools,
Norfolk, Virginia
HOWARD P. MCCOLLUM (1962)
State Department of Education,
Baton Rouge, Louisiana
JAMES A. RUTLEDGE (1962)
University of Nebraska, Lincoln,
Nebraska
DOROTHY VAUGHN (1963)
Neodesha High School, Neodesha,
Kansas

SCIENCE CONSULTANTS

WILLIAM JONES BOWEN, National Institutes
of Health, *Biology*
PRESTON E. CLOUD, JR., U. S. Geological
Survey, *Earth Sciences*
LEO SCHUBERT, American University,
Chemistry
HOWARD J. LASTER, University of Maryland,
Physics
FORREST WESTERN, U. S. Atomic Energy
Commission, *Atomic Energy*

*The National Science Teachers Association
is a department of the National Education
Association and an affiliate of the American
Association for the Advancement of Science.
Established in 1895 as the NEA Department
of Science Instruction and later expanded as
the American Council of Science Teachers,
it merged with the American Science Teach-
ers Association and reorganized in 1944 to
form the present Association.*

Journal of the National Science Teachers Association Volume 28, Number 4 • May 1961

THE SPACEMAN'S PHYSICS <i>Bancroft W. Sitterly</i>	6
AN NSTA COMMITTEE REPORT: Part I, Mission to Glasgow and London	10
Part II, European Science Teacher Study Tour	21
A-OKAY TRIBUTE TO FREEDOM 7, ALAN B. SHEPARD, JR.	25
CULTURE MEDIA FOR PROTOZOA AND ALGAE A selection from a series of Culture Leaflets	27
ACTIVITIES IN ASTRONOMY <i>Arthur G. Suhr</i>	28
CRITERIA FOR INDEPENDENT STUDY PROJECTS <i>Donald Wynant Huffmire</i>	32
CLASSROOM IDEAS An Inexpensive Planetarium Dome <i>William M. Thwaites</i>	38
Teacher-Made Slide Rule <i>William MacDonald</i>	39
The Use of Unknowns <i>T. W. Jeffries</i>	41
BOOK REVIEWS	51
SCIENCE TEACHING MATERIALS Book Briefs	54
Professional Reading	59
Audio-Visual Aids	61
Apparatus and Equipment	65
EDITORIAL	4
LETTERS	5
NSTA ACTIVITIES	43
NSTA CALENDAR	49
INDEX OF ADVERTISERS	66



A Salute to Science Teacher Leadership

Rich, rewarding, and reassuring sentiments are difficult to convey. Yet, if each fellow science teacher could have traveled across 10,000 miles of the country with me and met with several thousand NSTA members, then indeed we could share mutual feelings derived from our similar experiences. From meetings in small rural schools to large sophisticated urban conclaves, one factor was obvious—progress. Teachers endeavored to learn about new advances in science teaching, to increase their backgrounds, and to move on with curricular developments. The opportunities offered by the National Science Foundation and industry-sponsored teacher institutes served as a catalyst to advance interest in the growth of our profession. Yet, it is to the credit of individual teachers that they have taken the initiative and made an effort to establish fundamental improvements in their profession.

Examine with me a few of the outstanding examples of our progress in science education. Probably the most exciting and important developments have occurred in the NSF-sponsored research of our course offerings. Such work as produced by the Biological Sciences Curriculum Study, the Chemical Education Material Study, the Chemical Bond Approach Project, the Physical Science Study Committee, and advanced studies in the earth sciences and mathematics will bring the newest advances in subject matter along with the best in methods to the door of every classroom. Not only the remarkable results produced by such studies, but also realistic grounds for optimism are found as college professors and secondary school

teachers work together in these essential areas. Together they open new avenues of cooperation and understanding pointing toward a bright future in science education.

These new developments, however, will remain at the classroom door unless the teachers are able to utilize them. Too many teachers find themselves in situations where excessive work loads preclude adequate attention to research into curricular development. It is essential that school officials and the public realize that genuine progress will result only when the teacher is permitted to exercise his training, experience, and intelligence in a creative climate.

Alan T. Waterman, Director of the National Science Foundation, says, "It must be admitted that as a people and a Nation we have not been properly appreciative of intellectual achievement. This awareness and appreciation is not something the Government can legislate into being. We must build it into our national consciousness through our educational system, and until we do, science and all other forms of intellectual activity will lack the firm foundation they require." This awareness and appreciation whereof Dr. Waterman speaks can only be achieved by the catalytic action which occurs through teacher leadership.

Fortunately, many teachers already realize that the opportunity to initiate leadership is directly reflected by the increased pulse of activities in our national organization. A growing and active membership has resulted in establishing such an outstanding program as the Future Scientists of America. The influence of the American science teacher is beginning to be felt in other countries through the developing international scope of NSTA. The experiences of this year have served to strengthen my conviction that the science teacher is vital to our way of life; he must be encouraged and assisted in every way possible.

As this year comes to a close, I wish to thank the membership for making it possible for me to serve as your president. I know you join me in welcoming to office the new president, J. Darrell Barnard.

ROBERT A. RICE
President, NSTA (1960-61)

THE SCIENCE TEACHER

Volume 28, No. 4 — May 1961

The Journal of the National Science Teachers Association, published by the Association monthly except January, June, July, and August. Editorial and executive offices, 1201 Sixteenth Street, N.W., Washington 6, D. C. Of the membership dues (see listing below) \$3 is for the Journal subscription. Single copies, \$1. Copyright, 1961 by the National Science Teachers Association.

Second-class postage paid at Washington, D. C. Printing and typography by Judd & Detweiler, Inc., Washington, D. C.

Articles published in *The Science Teacher* are the expressions of the writers. They do not, however, necessarily represent the policy of the Association or the Magazine Advisory Board.

OFFICERS OF THE ASSOCIATION

ROBERT A. RICE, *President*, Berkeley High School, Berkeley, California

J. DARRELL BARNARD, *President-elect*, New York University, New York City

DONALD G. DECKER, *Retiring President*, Colorado State College, Greeley, Colorado

MILDRED T. BALLOU, *Secretary*, Ball State Teachers College, Muncie, Indiana

J. DONALD HENDERSON, *Treasurer*, University of North Dakota, Grand Forks, North Dakota.

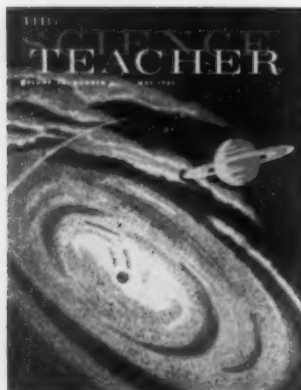
ROBERT H. CARLETON, *Executive Secretary*, 1201 Sixteenth Street, N. W., Washington 6, D. C.

MEMBERSHIP

The membership year extends for one year from date of enrollment. Subscriptions are entered for either the calendar year or the school year.

Regular Membership	\$ 6.00
Sustaining Membership *	10.00
Student (college and university) Membership	2.00
Life Membership *	175.00
Payable in ten annual installments; \$150 if paid in three years or less.	
Library Subscriptions *	8.00

* Includes the *Elementary School Science Bulletin* published monthly from September through April of each year.



THIS MONTH'S COVER . . .

What are the conditions in outer space? What lies between our universe and the stars or planets that surround it? The atmosphere is rich in wonder and knowledge. It offers a fertile environment for philosopher, scientist, artist, or dreamer. It provokes the inner mind of child or adult as he ponders on the mysteries of the galaxies.

In the lead article (page 6), Dr. Bancroft Sitterly, physicist and astronomer, describes the environment of a spaceman in a "typical" region within our galaxy.

The drawing is from a reprint slide made available and reproduced by permission of the U.S. Navy.



Beware of Rockhounds

The public schools face many problems connected with the rapid increase in the number of America's rockhound population. Most school teachers are on-lookers as thousands of rockhounds learn on their own initiative and take mineralogy courses by television from outstanding museums such as the Oregon Museum of Science and Industry in Portland, Oregon.

These gregarious and articulate rockhounds may actually invade the nation's schools before teachers are ready for them. Once a classroom becomes invaded, a teacher is forced to play the tragic role of a silent onlooker as the rockhound coyly reveals his diamond, or fossil, or petrified snail to a captive audience. Children often catch the rockhound fever and revel in the joys of self-instruction and freedom from the pedagogical strait jacket. Or, worse yet, they may turn on their teacher and terrify her with such questions as "What makes emeralds green?" "Why are quartz crystals hexagonal?" or "How can you tell the age of this fossil?"

Perhaps the following warning should be posted in teachers' lounges: "Beware of rockhounds and rockhound fever; both are fatal to teachers who have not been inoculated with the academic virus of earth science, mineralogy, geology, or time-tested physical geography."

JOHN SHAFFER
State University of New York
Cortland, New York

A Personal for the Executive Secretary

I have arrived back in Australia and wish to thank those who helped particularly in making my year's leave and stay in America such a pleasant experience. Your assistance in driving me to a motel outside Princeton began a wonderful few days, especially when Dr. Hubert Alyea contributed his hospitality by taking me to his own comfortable home on the campus for the rest of my stay. He is a man after my own heart—thoroughly enthusiastic about the teaching of science and its improvement! From there began visits to Harvard, Brown, Massachusetts

Institute of Technology, and Phillips Academy at Exeter. Then went to Chicago and visited educational environs at all levels, then to the majority of the "Big Ten" universities. Finally off to Phoenix, Arizona, and the Grand Canyon as a respite from over-indulgence in chemistry. Recuperated, I spent the remainder of my time in California where again I saw all the top institutions at secondary and tertiary level.

The books and pamphlets you sent me arrived safely and were well used at a summer school just concluded for 130 science teachers. I had also both the CBA and the CHEM Study books and am still not quite sure whether they caused more alarm or delight! Much of our science teaching is old-fashioned and traditional, and I could wish for a magic carpet to transport half a dozen or so of the men I met in the USA to help in transforming it.

J. J. BROE
School of Chemistry
University of Sydney
New South Wales, Australia

EDITOR'S NOTE: As part of his leave of absence, Professor Broe came to visit colleges and universities and secondary schools to meet and talk with leaders in science education.

We are honored that one of his first stops was NSTA Headquarters in order to find out about our Association and to obtain help in arranging final details of his study tour. We hope for future visits.

From Reader to Author

I should be interested to know if you have not omitted three possible answers in the sample examination in the article "Teaching Three Dimensions in Biology" (*The Science Teacher*, February 1961).

On page 8, Problem II, part 2, you give "B" as the only answer. How about "C" (by cutting a vertical plane through any diameter of the cylinder) and "D" (by cutting a plane vertically through the equator of the sphere)? In part 3 of

the same problem you give "C" and "E" as answers. Why not "F" also (by cutting a horizontal plane through the hollow cylinder)?

The article was informative, and I think will prove useful to me and to other science teachers. Three-dimensional comprehension is difficult to teach, and you have certainly presented a clear cut method of getting started in learning three-dimensional visualization.

JOHN DREYFUSS
Robert Louis
Stevenson School
Pebble Beach, California

Your interest in the "3-D" article is appreciated. I have re-examined the questions which you raised, and in terms of our own interpretation of what we have said or think we have said, the answers you suggest would not be correct. First, let me point out that it was our intention for the problem to be limited as follows:

1. "... a slice cut with parallel lines in any one plane were cut from any plane through object." This is meant to limit the problem to a single cut.
2. "... the outlines below represent the surface of a slice cut through one or more of the above objects." This is meant to be interpreted that the outlines below, numbered 1, 2, 3, etc., represent only the slice cut and not any exposed surface other than the one cut.

In terms of the above limitations, we would interpret a vertical plane through any diameter at the cylinder of "C" as a rectangle and a vertical plane cut through the equator of "D" as a circle. We would interpret cutting a horizontal plane through "F" as providing a circle as illustrated in No. 4 or a vertical cut as providing the type of figure illustrated in No. 7.

ADDISON E. LEE
Science Education Center
The University of Texas
Austin 12, Texas

DEMONSTRATION PIPES

Here is something new for teachers. Twelve middle "C" genuine organ pipes of copper, lead, zinc, tin and wood which actually play. Complete with hand-operated wind supply, they can be tuned and voiced. Shows relationship of length to pitch.

Includes descriptive manual giving history of each pipe. Ideal for instruction in organ, physics, acoustics, and for general music appreciation.

Easily moved. Attractive conversation piece. Complete with teacher's manual, only \$245.00 plus freight from Los Angeles.

SATISFACTION GUARANTEED.



The Spaceman's Physics



By **BANCROFT W. SITTERLY**

Professor of Physics, The American University, Washington, D.C.

PHYSICS is a method by which we understand and deal with our experience. As such, the basic concepts depend, to a larger extent than is realized, upon the fact that we live on the surface of a medium-sized planet located at a medium distance from a medium-sized star. In physics, as students are introduced to it the most prominent force-across-a-distance is the earth's gravity, so that g is the first physical constant that a beginning student learns. Currently, matter is typically organized into rigid bodies, liquid aggregates, and gases of density comparable to that of the base of the atmosphere. The balance between incoming and outgoing radiant energy at the earth's surface keeps earth temperatures near that range within which water under atmospheric pressure is a liquid. Matter is considered to be habitually inert, electrically neutral, and magnetically unpolarized. "Electricity" originally meant "the peculiarity of rubbed amber" and "magnetism" meant "a wonder reported from that remote region, Magnesia." In elementary physics courses, falls and collisions

are the happenings first investigated.

These conditions are in fact *exceptional* in the universe at large. Consequently, it may be profitable for a student (or teacher) of physics to ask how physics would appear to an intelligent observer who examines his surroundings in a location far removed from earth's familiar environment. What characteristics of matter would an inquiring spaceman find most noteworthy?

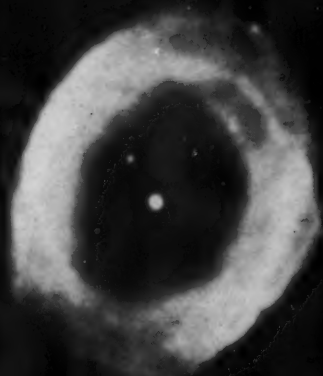
Let us place our spaceman first in a "typical" region within our galaxy, but neither in its central region nor near its edge, among the stars but not in the immediate neighborhood of one. At first he will consider himself to be in a complete vacuum, aware only of the weak radiation from the distant stars surrounding him. Actually he will be surrounded by matter, dust grains, free atoms, and an occasional simple molecule, forming an almost inconceivably tenuous cloud extending indefinitely in all directions. The atoms are mostly those of hydrogen, but traces of the commonest light elements, such as carbon, nitrogen, oxygen, sodium, cal-

cium, titanium, and iron, and more than a trace of helium, are present. They are spaced on the average about half an *inch* apart, and in this gas an atom will commonly travel for a *week* between successive collisions with other atoms. The most frequent diameter of a dust particle is perhaps a micron ($1/25,000$ inch) and the distance between adjacent grains approximates a quarter *mile*. Among the atoms and dust, the ions that are known as primary cosmic rays streak in all directions at speeds approaching that of the velocity of light.

In such highly dispersed matter, mechanical activity and thermal phenomena do not appear as they do in terrestrial laboratories. The behavior of the atoms depends more on their individual absorption and re-emission of the radiant energy from the distant stars than on the atoms' encounters with their neighbors. Insofar as the atoms may be said to have a temperature, it is defined by the distribution of their velocities. It is estimated that around our spaceman atomic temperatures may average halfway between

The Ring Nebula, Lyra—a "hot star," illuminates a gas cloud.

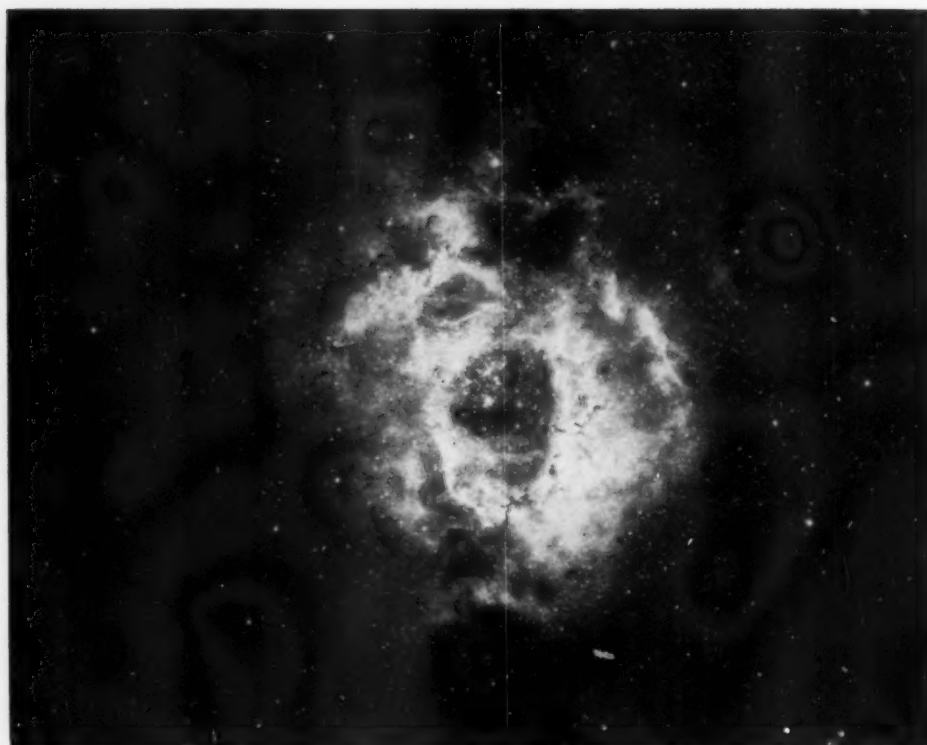
MOUNT WILSON OBSERVATORY



Centigrade zero and Absolute zero. The spaceman's thermometer, however, will not show this. The reading of the thermometer will indicate the temperature at which it absorbs and re-radiates energy equally; here this temperature will be about 3°C above Absolute zero, or -270°C . This will also be the temperature of the dust grains. As for mechanical forces prevailing in these depths of space, of course the gravitational attraction of even neighboring grains on each other is inappreciable. A weak gravitational field does exist, due to the vast mass of the galaxy as a whole, and under this the entire medium, gas and dust, sweeps around the galactic center in a gigantic orbit. The speed of this motion is high (in the solar neighborhood it is nearly 200 miles a second) and it varies with distance from the center, so eddies on a grand scale will occur because of shear between regions of different speeds. Other forces are appreciable, though also weak. Particles as small as these are perceptibly accelerated by absorbing momentum from radiation they intercept. Moreover, this radiation will ionize a small fraction of the free atoms, and the ions and electrons

Andromeda Galaxy, an island universe of stars so clustered together that it blazes like a whirling Fourth-of-July pinwheel. It is considered a twin of the Milky Way Galaxy that holds the earth and its sun. The two bright objects outside the spiral itself are dwarf satellite galaxies which accompany Andromeda.

NATIONAL GEOGRAPHIC SOCIETY—PALOMAR OBSERVATORY SKY SURVEY



NATIONAL GEOGRAPHIC SOCIETY

The "Rosette" Nebula, a glowing cloud excited to shine by "hot stars." Note dark streaks of dust silhouetted on the glow. The Milky Way stars seen are mostly in front of the nebula.

formed will each possess a minute electric field and, because it is moving, a minute magnetic field. The magnetic field in turn will divert other charged particles in motion. Though deep space is no region for studying the behaviors that Galileo, Huygens, Hooke, and Newton made intelligible, it is a natural laboratory for atomic physicists.

If our spaceman transfers himself to another region, within a few light-years of a really "hot star" (but still remains far outside the reaches of its planetary system), he will find a change in the character of the tenuous medium surrounding him. Here radiation is still weak, and comes largely from stars at great distances all around, but the "hot star" supplies a uni-directional component of this, differing from the rest in that it is predominantly at ultraviolet frequencies. The effect of this is almost completely to ionize the free atoms in space. They become not a classical gas but a plasma. Electrical forces now control individual encounters, and though mixing of the freed electrons and the positive ions washes out any general electric field, turbulent motions in the plasma may result in perceptible magnetic fields. The encounter with an ultraviolet quan-

tum of radiation that ionizes an atom powerfully accelerates the resulting ion and electron, so that individual random particle speeds in the plasma correspond to a temperature of $10,000^{\circ}\text{C}$ or more (but the surfaces of dust grains are still near Absolute zero). Also the radiation pressure from the "hot star" pushes the whole medium outward. An extremely faint glow pervades the region. It is emitted by the ions as their still-attached electrons settle down into stable configurations after the disturbances produced when they intercept radiant energy. The spaceman cannot perceive it immediately around him, but the enormous extent of the surrounding clouds provide enough glow to render his sky very faintly luminous. Looking at him from our own earth, we see that he is in an extended nebula.

Our spaceman's interest may next be transferred to the "hot star" itself—undeniably an identifiable physical object, quite different from a grain or an atom, and the only kind of object that he can really see anywhere near him. He now approaches this closely (with suitable protection) and examines it by all available means. Once more, he finds it unearthly. From the very small he has gone over to the very large, from



MOUNT WILSON OBSERVATORY

Dark gases obscure the "hot stars" in this area—the Nebula M-8, referred to as Sagittarius.

low to extremely high temperatures, from near darkness to blinding radiance. The star is an object, but its material is not terrestrial matter in any ordinary form. It is closely packed, except near the star's visible surface (which is not really a surface but a layer between opaque and transparent regions of the star). The star contains as much matter as does a region of deep space perhaps fifty light-years on a side; the major part of this matter is compressed to a density greater than that of solid iron. Yet no part of the star is solid, or even liquid; it is all gaseous, and all except an extremely tiny fraction, monatomic plasma—a mixture of free electrons and completely or nearly stripped nuclei—nuclei of the same elements that our spaceman found in "empty" space. The radius of a nucleus is so very much less than that of an atom with all its electrons that nuclei may be forced together until their separation is a small fraction of an atomic radius, and there is still enough room between them. The temperature through most of the star is more than a million degrees Centigrade, and between the particles there is a constant flow of radiation of extreme intensity and frequency, predominantly in the extreme ultraviolet and X-ray regions.

In these conditions the spaceman at last recognizes something familiar. He is investigating a supercolossal thermonuclear reactor. The central region of the star is the core. The outer regions are at the same time the shielding, the heat exchanger, and the moderator. The structural principle is simple.

Gravitation holds the mass together; gas pressure and radiation pressure hold it apart. The point of balance depends on the temperature. If the energy production increases, the temperature rises, and so does the pressure. This expands the star, and the expansion lowers the temperature, decreasing the energy production, which also depends on the temperature. In turn, the pressure drops, the star contracts, and temperature and energy production again increase. The alternation is self-damping in this case—evidently so, for the star is in fact stable. Energy from the core is passed to the surface partly by radiation from ion to ion, partly by a convective layer of ascending and descending streams of plasma. The whole star rotates, but with a systematic turbulence that is not clearly understood yet, and involves not only the mechanics of the plasma, but the interaction of the magnetic fields generated by its motion. At the star's surface, the density of the matter becomes very

low, the gravitational force moderate, and the intense radiation takes over. The upper stellar atmosphere is in violent turbulent motion of a very complex sort, but with a strong outward trend, so that ions and electrons are projected away from the star with very high speeds. A star of this sort may have an expanding envelope, many times larger than the star, visible at great distances.

Such, then, is a star. Such is our own sun, though it is not as large or hot as the one our spaceman has examined, and does not energize a vast region of space to glow. Of all the matter in the universe as now known, it is thought that nearly half is organized into stars, and most of the other half is gas and dust clouds of the kind first described, though many of the clouds are much denser than these. Fortunately, there is a bit left over to make up bodies like the earth, on the surface of which, if he finds one, our spaceman may study an *earthman's* physics.

An edge of the sun discloses violent turbulence; prominence and a sun spot shown.

YERKES OBSERVATORY



AN NSTA COMMITTEE REPORT . . .

PART I

Mission to Glasgow and London



JANUARY 1, 1961 THROUGH JANUARY 17, 1961

MEMBERS of the delegation to Glasgow and London were Robert H. Carleton, Executive Secretary of NSTA; Ralph E. Keirstead, State Department of Education, Hartford, Connecticut; Abraham Raskin, Hunter College, New York City; Fred R. Schlessinger, The Ohio State University, Columbus; and Zachariah Subarsky, The Bronx High School of Science, New York City.

The mission undertaken by the NSTA group was financed by the Association with added support from the National Science Foundation. The total expense amounted to approximately \$3300 and of this amount \$2500 was provided by NSF.

Purposes

Why did the National Science Teachers Association decide to sponsor and provide partial support for this project in international activities?

Perhaps the answer to this question may be clarified by examining the statement of purposes of NSTA's Committee on International Activities.

"To initiate, foster, and promote activities on the part of the Association, its members, and science students that will have the following purposes:

1. To gain a knowledge and understanding of the objectives, problems, culture, and job realities of our counterparts abroad.
2. To transmit to our friends abroad a knowledge of our own situation culturally and professionally.
3. To work cooperatively with our colleagues abroad toward the solution of common problems.
4. To apply directly in our own situations the best of what we see abroad in methods, materials, and facilities.
5. To provide direct professional assistance to groups temporarily less fortunate than ourselves.
6. To provide opportunities for science teachers to profit inspirationally from visits to such scientific shrines as the Cavendish Laboratories at Cambridge, the Pasteur Institute, and the Joliot-Curie Laboratories.
7. To provide opportunities for science teachers to add to their intellectual capital through visits to such establishments as the giant radio-telescope at Jodrell Bank, the European Center for Nuclear Research at Meyrin, and the Delta Plan in Rotterdam.
8. To broadcast our new knowledge and understandings to our fellows

here in the United States through our journals and by word of mouth."

The Science Masters' Association (SMA) meetings at Glasgow; the meetings at the Ministry of Education in London with science education leaders from England, Nigeria, Bahrain, India, and Iran; the visits to Dulwich College, Kingsdale School, Hatfield School, The Royal Grammar School at High Wycombe, Cambridge University; and to the headquarters of the SMA at Cambridge provided us constant opportunity to work toward the attainment of the first three objectives. Through these experiences, each of our group is able to give representative views of the benefit and effect produced as a result of the exchanges with others. This report represents an effort in which the group may disseminate the new knowledge and understanding derived from our participation with the international community.

Preparation of the Science Master

Great Britain, similar to the United States, is currently suffering from a dearth of teachers. The most serious shortages are in the fields of science, mathematics, physical education, domestic science, and handicrafts.

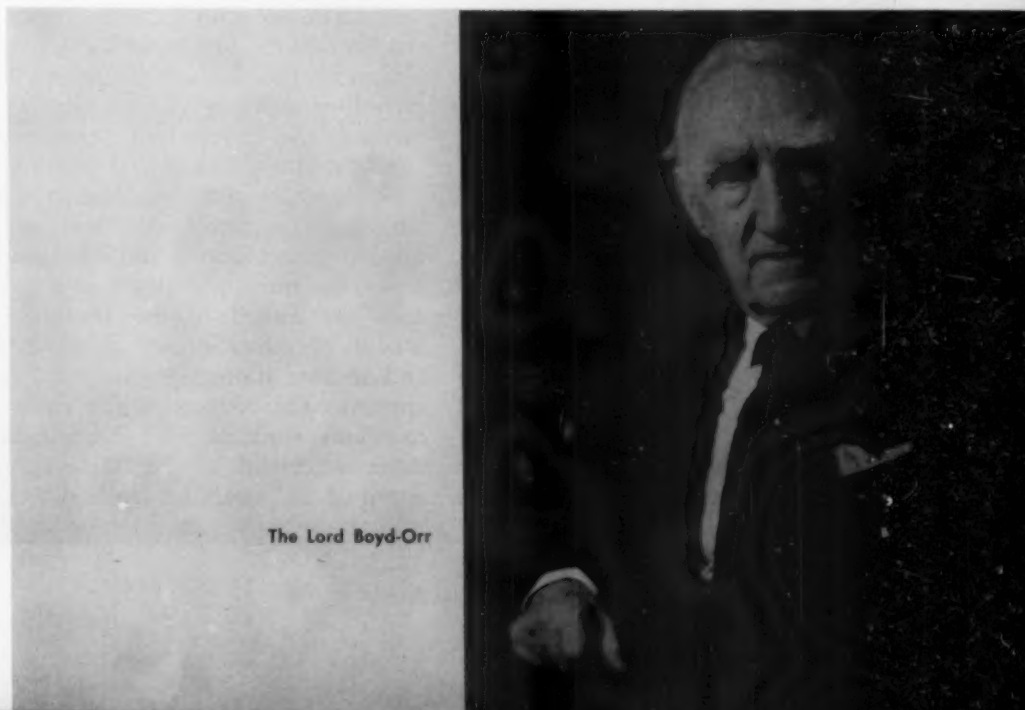
The science masters we met both at the Glasgow meeting and at the various schools visited were, in general, well prepared. Many, particularly those who taught in the grammar schools, were graduates of Oxford or Cambridge with "firsts" in their fields of specialization. The dedication and interest of most of these teachers were more evident here, particularly to one

who fears that the profession of the secondary school teacher is degenerating into an attitude of "just another job" in his part of the country. At the schools visited, teachers worked with such equipment and facilities that we would term in the U.S. as average. The class size in general compares to ours. The teaching load, however, is considerably heavier. At High Wycombe, a first-rate grammar school, some of the science masters were teaching a total of thirty-five hours a week. We might assume that this is not uncommon in other areas.

How does one become a science master?

An individual seeking a career as a teacher of science in a publicly-aided school in England or Wales must be approved as "qualified" by the Ministry of Education. To achieve this status, he must first graduate from a secondary school. The would-be teacher may then elect to attend a university or he may decide to study at a training college.

If he chooses to be a prospective teacher of science, in chemistry, he takes a program of studies at one of the seventeen universities in England and Wales. The program is precisely the same as the one taken by a would-be chemist. Both will study the classics, other areas in the humanities, the social sciences, chemistry, and other natural sciences and mathematics. Neither will take courses in education. At the conclusion of this university program, the graduate is declared as "qualified," and he may proceed to find employment in a secondary school.



The Lord Boyd-Orr



Colin Campbell (extreme right) of Moray Teachers College in Edinburgh served as SMA host at our dormitory. The group enjoys a late tea break after an evening session. During the SMA meetings, breaks for tea twice a day were observed standard practices.

He may prepare himself further by taking a postgraduate year in education at a university. These programs are generally supervised by area training organizations.

The program at the University of London for the Postgraduate Certificate (formerly the Teacher's Diploma) extends over one academic year. Applicants must be university graduates, and, as a general rule, must have taken an accepted honors degree.

The regulations require students to take courses leading to an examination in the following subjects:

1. Principles of Education.
2. Special Methods.
3. Psychology and Health Education.
4. The Present Educational System of England and its recent history.
5. Psychology at a level higher than in 3, or Comparative Education and Administration, or Development of Education in Tropical Areas.
6. Practical Training in Teaching.

Optional courses, largely in the humanities, may also be taken during the year.

The University of London also offers both the MA and PhD degree in Education.

If the secondary school graduate finds it difficult to obtain a place in a university or for some other reason

decides not to attend a university, he may become a "qualified" teacher by attending one of the 155 training colleges in England and Wales. Many more of these are now being built. Scotland has its own Ministry of Education, school inspectors, and teacher training program which, incidentally, requires a year of professional training in a Department of Education. Local schools in Scotland do share in receipt of supporting funds from the British Ministry of Education, however, as do other schools in the United Kingdom.

In England and Wales, the training college course normally lasts three years. The program includes studies in the liberal arts, in special subject matter areas, in the mental and physical growth of children, and in educational methods and observations, and supervised teaching. The period of training may be shortened for older persons who have specialist qualifications in art, handicraft, music, and other areas.

All the training colleges in a given area are linked to the institute or school of education of a university and an area training organization that approves the courses at the colleges, examines students, and recommends those successful to the Ministry for approval as "qualified teachers." The area training organization generally

consists of representatives from the university and its department of education, the training colleges, and local education authorities.

The Ministry of Education is the only organization which certifies that a teacher is "qualified." It can also withdraw the "qualification" for sufficient reasons. The Minister, like our own accrediting organizations, is currently hard pressed to find a sufficient number of properly qualified teachers of science. He has therefore opened other paths to qualification in addition to the normal demands; i.e., approved courses of training. A long period of satisfactory service as a non-qualified teacher or graduate membership in certain scientific institutes are two of the alternate routes to qualification.

"Qualified" teachers are required to serve a probationary period during which they "may be required to satisfy the Minister of their practical proficiency." This period is generally for one year, but it may be extended or waived entirely.

The Minister has also approved the employment of temporary teachers, generally for periods of two years. Temporary teachers may be in the process of preparing for qualification or may have failed to complete a course of teacher training satisfactorily. For the latter group, this represents an opportunity to retrieve their failure.

As in the United States, scholarships of various kinds are available for prospective teachers. Those attending the training colleges may receive financial help to cover the cost of tuition, board and lodging, traveling, and other personal expenses in accordance with their own or their parents' means. Students attending universities may obtain scholarships offered by the Ministry of Education, local education authorities, or by the universities themselves. More than three-quarters of the students at English and Welsh universities receive some form of financial assistance.

Finding a Job

The path to employment and to advancement for British science masters is generally the same as for science teachers in this country. They may apply for positions as teachers, as heads of department or principal science masters, or as headmasters of

schools. Science masters are made aware of such opportunities through advertisements by various educational authorities in the weekly educational supplement of *The Times*, or in professional journals, or by recommendations. The variety of these positions was amazing to us. Here are a few examples culled from advertisements in *The Schoolmaster and Woman Teachers' Chronicle* (Journal of the National Union of Teachers):

"Qualified mistress to offer two or more of the following subjects: General Science, Music, Art, Religious Knowledge."

"Vice Principal, Liverpool Collegiate School"; "Cookery mistress."

"Master or mistress to take general subjects with an interest in teaching slower groups."

"The Authority is looking for a man with a progressive outlook, interested in simple woodwork and prepared to help with the school poultry club."

There seems to be no end to the variety of positions, or to the inducement offered. Here are some typical inducements:

"The new school building is situated on a delightful dale-side."

"The school offers up-to-date facilities . . . two fully equipped laboratories and a laboratory assistant."

"Free board and lodging for single man. Free house and services for married man."

"In certain circumstances assistance toward removal expenses of married teachers appointed from outside the geographical county may be provided, lodging allowance paid for periods up to six months, and there is a scheme whereby substantial loans can be made with a repayment period up to 30 years in approved cases."

Facing Professional Responsibilities

The science master may teach in any of several kinds of secondary schools—Public (Independent), Grammar, Secondary Modern, Technical, or Comprehensive. With additional preparation, he may teach in any of a variety of special secondary schools such as those for the physically handicapped or for the maladjusted.

The school year begins in September and continues until late July. It is divided into three "terms" separated by vacations at Christmas and at Easter, each lasting about three

weeks, and a summer vacation of six or seven weeks. Mid-term is usually marked by a long weekend of three or four days' duration.

Typically, the school day (from 9 a.m. to 4 p.m.) consists of four periods in the morning with a break of 10 or 15 minutes between the second and third periods. Then follows a lunch period of an hour and a half, after which there are four more periods with a break of 10 or 15 minutes between the sixth and seventh periods. Some schools have another variety of scheduling a function, that which, incidentally, is the responsibility of the Headmaster.

In Britain, a master in a secondary school teaches pupils ranging from age 11 to age 19. This is for pupils who enter the British secondary schools after having passed the known "11 plus" examination—so-called because it is taken during the year a boy or girl passes his eleventh birthday. The examination is designed to measure general aptitudes with attainment in arithmetic and English.

If he is employed in a Grammar School, a schoolmaster will be preparing his students for university entrance. In the early forms, his courses of study will be profoundly influenced by the GCE (General Certificate of

Education) "ordinary level" examinations that his pupils will take for the first time at age 16. With upper-form classes, the master will be preparing his students for "advanced level" and scholarship examinations.

In the lower forms a science master will be teaching general science. But even before a student reaches his upper forms, if he shows promise, he will be directed into the study of physics, chemistry, or biology, any two of these, or even all three. It is noteworthy that although pupils are promoted through the forms by age, they nevertheless proceed in their studies at their own pace. Even on entering the secondary school, students are classified into two or three "streams" but not irrevocably. As they go on with their studies, students are promoted or demoted from stream to stream in accordance with their performance. Moreover, a student may be in a rapid stream for one subject—say mathematics—and in a slow stream for another—as French.

A science master teaching sixth-form classes teaches specialized science at an advanced level—equivalent to our college level. A student may remain in the sixth form for two or three years, that is to say up to the age of 18 or

Following the presidential address of The Lord Boyd-Orr at Bute Hall, SMA members and guests attended an enjoyable social where coffee and dessert were served.



19. He takes five subjects specializing in two or three, for example, mathematics, physics, and chemistry; or physics, chemistry, and biology; or mathematics, advanced mathematics, and physics. There are similar combinations for students specializing in the arts or in the humanities. About 60 per cent of all sixth-form students, at the present time, specialize in science.

In a secondary modern school, a science master may be assigned to teach classes preparing for the GCE "O" level examinations. But he is just as likely to be teaching general education courses or even vocationally oriented courses. He may even be assigned to teach classes of slow learners, most of whom will be leaving school at age 15. In a technical school a science master would be preparing pupils for GCE ordinary level examinations and also for advanced level examinations based on instruction in technology, whenever necessary.

In a large city, a science master may find himself teaching in a comprehensive secondary school with anywhere from 1000 to 2000 pupils, classified as to ability and directed into a variety of courses and streams.

In many schools the science master will enjoy the benefits of a laboratory assistant, and in some schools he will teach with superb facilities and equipment. However, he may become a

"careers master" in others and be given the responsibility of advising pupils on suitable careers.

A master's salary is built upon a basic salary scale to which additions are made depending on additional education and responsibilities. The basic salary scale is 520 pounds (\$1456) per annum rising by annual increments of 27 pounds (\$77) to 1000 pounds (\$2800) per year. To this scale is added, at minimum and at maximum, various amounts for approved full-time courses for a graduate degree, or for an honors degree. Additional allowances are granted for Head Teachers, Deputy Teachers, and Heads of Departments, the latter according to grades: Grade A, 150 pounds (\$420); Grade B, 240 pounds (\$672); Grade C, 330 pounds (\$924); Grade D, 420 pounds (\$1176).

There are differentials even within the grade of teacher, additional salary being paid to teachers undertaking special responsibilities, advanced work, etc. Other factors that may influence salaries are the size, nature, and location of a school. All this is described in detail in an official document known as the *Burnham Report*. It is of special interest to note that as of 1961-62 the salaries for men and for women will be the same at all levels.

A beginning teacher will receive, informally, much help and guidance from his Headmaster and from more experienced colleagues. But he is soon very much on his own in meeting his responsibilities in the classroom. It is taken for granted that he will grow in independence as he matures professionally. One of the masters with whom we spoke was horrified to hear that in some American schools, department heads visit classes and write reports which teachers are obliged to sign, and that these are placed in the teacher's file for permanent reference use.

Organization of the Curriculum

A basic objective of the English educational system is to provide for each student a program of study which is suited to his aptitude, his ability, and his maturity. To accomplish this objective, it is necessary, first, to assess the capabilities of students and second, to provide a variety of programs into which students may be directed on the basis of the assessment of their capabilities. Apparently the assessment of

the capabilities of students in England is based somewhat less on formal testing and somewhat more on performance in classwork than in this country. Examinations based on subject matter, and set by agencies outside the individual school, play a prominent role in assessing the capabilities of students and in determining their future educational programs. At the secondary level, it has been the common pattern to provide separate schools to serve students of different capabilities. Thus, grammar schools are essentially preparatory schools for the universities. While there has been a movement toward comprehensive secondary schools, somewhat similar to many American high schools, it seems unlikely that the tradition of specialized secondary schools will change in England.

We are accustomed to think of a "course" as a horizontal "line" in the over-all curriculum. Thus we speak of "tenth-year biology" and "ninth-year general science." We say, "A student in our high school takes chemistry or physics in his eleventh or in his twelfth year." In general, we think of a course as being of a year's duration. At the end of the year, students take an examination, receive a cumulative mark, and breathe a sigh of relief. In the course of his year's work, the teacher seldom thinks of the student's past experience with the subject or of his future experience.

In the British system, the concept of a course is vertically oriented with respect to the curriculum. In other words, a course is considered to consist of two or three and up to six years of experience in a subject. It is interesting to note that we in the United States are just beginning to think in terms of a K-12 program in science education. To make any headway, we shall have to pry ourselves loose from our "horizontal" orientation.

Another noteworthy feature of the British program is the relationship between the teaching and evaluative functions. Through most of our high school years, the teaching and evaluative functions are combined in the teacher; the latter does the teaching and then judges its effects on the pupils. This situation tends to set up as the pupil's goal the mastery of the teacher rather than the subject. The implications in terms of variability in

In the museum of the University of Glasgow, the statue of James Watt is viewed by A. Raskin of NSTA (left) and H. P. Ramage of SMA (right).



Only in the later years of high school, when our pupils face College Entrance Board Examinations, does an attitude develop comparable with that which is common in British schools. A pupil feels that the teacher is not against him, but with him to help jump over a formidable hurdle. In England, the definitive evaluation function is in the hands of experts. It is true that a system of national or regional examinations can be a strong force for conservatism, but it can also be a strong force for change, and in a democratic system, the examiners are not likely to be unresponsive to the best thinking and judgment of the organized teaching profession. Nor indeed would they be insensitive to enlightened public opinion.

There is clear evidence that English schools make every effort to provide programs of study which are tailored to the needs of individual schools. For example, it is not unusual to find classes, at the upper levels of the secondary school, with fewer than ten students. Likewise the schedule for a school week is often quite complicated as a result of providing such a variety of special programs. Another indication of the concern for the individual student is the common practice of allowing students to spend an additional year in secondary schools in order to prepare for university scholarship examinations.

To conclude these impressions, it must be pointed out that the English educational system is a product of English history and culture and is designed to serve the present and future needs of the English people insofar as such needs can be discerned. Those aspects of science education in the



English secondary school which impress an American educator might not be readily transferable to the schools of this country for they have evolved from a different background and are designed to serve a different culture.

Apparently, there is a common view in this country that education in England is strongly centralized, with the Ministry of Education exercising a large measure of control and direction. Quite to the contrary, as the local autonomy in educational matters is even more zealously practiced and guarded than in the United States. The responsibility for providing educational opportunities is in the hands of local educational authorities, whose members are elected. The local educational authority delegates to the heads of schools responsibility for the program of that school. Thus, there can be significant variations in the programs in comparable schools under the same local educational authority.

Within an English secondary school, the Headmaster customarily delegates much responsibility for devising the program of instruction in the several subject-matter areas to the teachers of that subject. Secondary schools have Heads of Departments who receive extra compensation and who have very real responsibilities for the instruc-

These remarks should not be interpreted to mean that English education is without cohesiveness. There are strong and effective forces tending to bring about reasonable uniformity in the nature and quality of instructional programs throughout the country. For example, most science teachers are members of the Science Masters' Association (for men) and The Association of Women Science Teachers. These are mature professional organizations which, through national and regional meetings and through reports of committees, exert much influence on the content of courses and on the process of teaching. The prevalent custom of measuring the progress of students by means of examinations set by external authorities is another force tending to create uniformity in science instruction.

Undoubtedly, one of the most potent influences for uniform quality of education is the Inspectorate of the Minis-

try of Education. The Inspectorate is a body of about 500 experienced educators who provide liaison between the Ministry of Education and the schools. The majority of the inspectors are assigned to a region of the country. Within his region, the inspector is available to the schools for advice and consultation. Periodically schools receive a formal inspection in which a group of inspectors make a detailed examination of the school and its program. Following this, a report, often containing recommendations for change, is submitted. The school is under no compulsion to adopt the recommendations. Since the inspectors are members of the same agency, they reflect a uniform point of view on educational matters which must have a large effect, in the long run, on the nature and quality of education in the schools.

It is an important function of inspectors to provide the Minister of Education with information concerning the schools. Thus, it appears that the national government is well supplied with exact and current information as a basis for establishing national policies and enacting legislation affecting education at all levels.

Science Teaching Facilities

Since World War II the British have built many new secondary schools. Many of the older schools have been remodeled and at some of these, new science buildings have been constructed. Facilities for science teaching have received much attention in the last several years.

Even assuming that all the schools we visited were better than average, we were impressed by the physical space allotted for science instruction and by the equipment available for demonstrations by teachers and for experimentation by pupils. Science facilities in new schools appear adequate. This condition is related apparently to the rather close control of new construction exercised by the Ministry of Education. Instruction in science includes laboratory work by students. As much as a third of the time even in early years of the secondary school may be devoted to laboratory work. Equipment and supplies for this purpose seemed adequate in variety and in quantity. It should be emphasized that this condition may be due, in part, to the fact that science courses in the upper



Participants attending the International Conference at the Ministry of Education in London included (seated l. to r.): R. A. R. Tricker, Chief Science Inspector; J. G. M. Allcock, Chief Inspector of External Relations; J. O. Roach, Head of Overseas and General Division. Standing (l. to r.) are Keirstead, Schlessinger, Raskin, Subarsky, and R. K. Kichlu of India.

years of an English secondary school are equivalent to those often found in the first, or even the second, year in an American college. It would appear, however, that the nature and quality of science instruction in English schools are not usually limited by the unavailability of equipment and supplies.

In those schools that had been constructed within the last four to six years we found a definite type of teaching facility. The comprehensive schools usually had combination classroom laboratories similar in structure and furnishings to those found in the United States. In the schools visited, whether they were grammar schools with long histories of tradition or the more recently built comprehensive or technical high schools, we found the classrooms to be large for the number of pupils. Stockrooms were much larger than the usual stockrooms in the United States. Large preparation rooms were connected to one or two laboratories. Photographic darkrooms and optics rooms were available for student use. There were separate balance rooms in some of the schools, and well-equipped workshops for the construction of apparatus were found.

In the classroom laboratories used

by the lower forms in secondary education, the usual size allowed from 32 to 44 square feet per student. In the sixth-form laboratories, 64 square feet per student was the usual space allotment. In most of the schools a great deal of window space was provided, sometimes on both sides of the room. In spite of this large amount of window space, most of the laboratories and classrooms had dark curtains for completely darkening the room for projection purposes. The furniture in the laboratories was usually custom built, finished in highly polished natural wood. In all the newer schools the furniture was in excellent condition, even after several years of hard usage.

In some of the classrooms the amount of storage space was so large that one got the impression there was much more storage space available than there was equipment to put into it. All of the laboratories were provided with gas, running water, and electrical outlets, both AC and low-voltage DC.

In most of the laboratories wooden stools were provided which matched the highly polished furniture. With the exception of some chemistry laboratories, most of the plumbing facilities were found along the sides of the room. The demonstration desks had hot and



NEW AO SPENCER SIXTY...

MAKES ALL OTHER TEACHING MICROSCOPES OUTDATED!

This remarkable teaching microscope by American Optical is all new from base to eyepiece . . . designed to help you teach more effectively and more creatively with the microscope than ever before. Yet this years-ahead microscope

is priced with the lowest student types. Turn the page to learn why the AO Spencer Sixty makes all other teaching microscopes outdated; and why it is your best buy today for real value and economy!

HERE'S WHY
THE AO SPENCER

Sixty

IS YOUR BEST BUY
IN TEACHING
MICROSCOPES



THE AO Spencer is full-sized, beautifully styled and made to take years of hard student use. It requires no lubrication and a minimum of periodic maintenance... you spend all your time teaching, not fussing with balky microscopes. So superior is the overall performance, that it gladly invites all comparisons... safely challenges all claims to superiority from any other teaching microscope offered at similar prices.

1 *Focusing Nosepiece:* A revolutionary concept! You focus the *nosepiece and the objectives* to the specimen. What could be more sensible? It's the smallest, lightest, most easily moved part of the instrument. There's no rack and pinion to wear or bind... to require cleaning and relubrication. Nosepiece is spring-loaded to prevent slide breakage.

2 *In-stage Condenser:* Every AO Spencer Sixty is supplied with a condenser as standard equipment to assure the finest over-all optical performance provided by its superior optical system. Where ordinary student-type microscopes have merely an aperture below the stage, the AO Spencer Sixty has

a permanently locked-in condenser...at no extra cost.

3 *In-base Illuminator:* Illuminator is integral part of base...plugs into any standard outlet. Your students simply push a button to get perfect illumination every time. Mirror is optionally available.

4 *Co-axial Coarse and Fine Adjustments:* You focus the nosepiece with separate co-axial coarse and fine adjustment knobs. Your students don't grope blindly up and down microscope arm for widely separated knobs.

And there's much more! For instance, the body is inclined for your students' viewing comfort; eyepiece has a convenient pointer as standard, at no extra cost; large base acts as a bumper to protect stage, objectives and nosepiece from striking vertical surfaces; epoxy finish will keep your microscopes looking like new for years and years.

Get the full story on the first *all new* teaching microscope to be introduced in more than 30 years. Write for full-color, 12 page brochure.



American Optical
Company

INSTRUMENT DIVISION, BUFFALO 15, NEW YORK

Gentlemen:

- ☐ I would like a demonstration of the AO Spencer Sixty.
☐ Please send me full-color, 12 page brochure.

Name _____

School _____

City _____ Zone _____ State _____

cold water as well as gas outlets and electrical outlets. Chalk boards and tack boards were limited in total area. An interesting innovation of the chalk board was the endless belt roller made of heavy cloth printed black or green and backed by a solid surface. This facility was used extensively both in the secondary schools and in colleges which we visited.

In most of the laboratories there was considerable shelf or cupboard space provided around the room. Usually these cupboards matched the tables and desks. We found these to be very neat and orderly, probably the result of having full-time technicians or laboratory assistants working in the science facilities.

Artificial lighting of the rooms in some cases seemed inadequate. One school we visited in Scotland had fluorescent lights. We were informed by the inspectors that many of the newer schools in England do have this type of lighting, too. Greenhouses were found in three of the six schools visited, but in only one school did we find an animal room for class use.

Perhaps the most conspicuous pieces of equipment found in the laboratories were large numbers of analytical balances. These were often found on the side shelves in the laboratories. In one school they were kept in a special balance room. We were told these balances were used by boys and girls from age eleven on. In some of the schools visited we found provision for one such balance for each two students in the classroom.

In the laboratory block of the High Wycombe Royal Grammar School the facilities were so arranged that interchangeable drawers of three different depths could be fitted in storage cupboards, demonstration desks, and classroom tables. These were custom built and would fit anywhere within the facilities of eleven different laboratories. The provision of space and materials within the laboratories gave the impression that the intention of the British science masters was to make laboratory work the heart of science teaching. This impression was reaffirmed in our talks with members of the Ministry of Education. We were quite aware that many of the schools which we were not privileged to visit are working under the same handicaps that we have here in the United States.

A general purpose of our mission was to attend the sixtieth annual meeting of The Science Masters' Association (SMA) at the University of Glasgow. A specific purpose was to learn more about SMA, to observe SMA in action and, without prejudice, to make some comparisons with NSTA.

SMA in Action

The SMA is about the same age as NSTA, if we consider NSTA's origin to be the NEA Department of Science Instruction (established in 1895). In terms of membership, SMA enrolls about 6000 science masters and college or university professors, a gain, they proudly announced, of nearly 1800 in the past year. If based on the total number of science masters in Great Britain, their percentage of membership is about twice that of American secondary science teachers in NSTA. There is a separate Association of Women Science Teachers and the merger of the two groups, which seems to be coming, might push the percentage even higher.

During the past year, SMA completed plans to establish and staff a headquarters. The Association took an eleven-year lease on a large, three-story house with a beautiful yard and small greenhouse at 52 Bateman Street in Cambridge, and spent some \$6000 in renovating, decorating, and partially equipping it for SMA purposes. Warden of SMA House is Mr. H. P. Ramage, a Cambridge graduate and retired science master. He is assisted by an employed secretary-librarian. Mr. and Mrs. Ramage occupy one floor of the house. Thus far, the headquarters have been set up as administrative offices with a library which could become a reference research center. NSTA has contributed to the center a complete set of all of our publications and will send copies of future publications. Issues of *The Science Teacher* and the *Elementary School Science Bulletin* go regularly to the center.

The schedule of SMA sessions comprising the meeting at Glasgow was not greatly different from that of an NSTA convention—except that the schedule was much less crowded and the pace much more leisurely. A major portion of the time was given over to lectures by scientists and other specialists, two or three usually being presented in parallel. Among the lectures offered at Glas-

gow were the following: "The Detection and Measurement of Elementary Particles and Quanta"; "The Boundaries of Science"; "The Chemical Basis of Heredity"; "The Human Sciences in a Scientific World"; "Educational Problems in USA and USSR"; and "Association Between Invertebrates and Unicellular Algae." Usually there was not time for discussion following the lectures, but in the corridors afterward could be heard the standard variety of comments: "An excellent presentation"; "I didn't follow all of it"; "Why don't they talk at a level we can use with our students?" and so on. One lecture, given in two installments, was especially well attended and produced much lively discussion; namely, "The Physical Science Study Committee Program of the USA" by Francis L. Friedman of Massachusetts Institute of Technology. He also had on display a full working array of the PSSC laboratory equipment.

The SMA meeting included film showings, exhibits by about 90 publishers and purveyors of equipment, and a special exhibition on "Atomic and Molecular Structure and Nuclear Energy" in which ten companies or agencies, including the United Kingdom Atomic Energy Authority, participated. A feature of the annual meeting of SMA is the members' exhibit of new teaching devices and demonstrations. Some thirty of these intriguing inventions—ranging from gadgets to high-precision arrangements—were on continuous display in a large laboratory with the originators there at stated hours to demonstrate and discuss. The nature of most of these devices was closely akin to many of our "Here's How I Do It" presentations. The kind of session common to our meetings but completely absent at SMA is the discussion-type session in which panels or small groups of participants exchange and share. Many of the science masters we talked with expressed a strong desire for opportunities of this kind.

The only meal function in the SMA schedule was a modest but extremely pleasant Association dinner held in a dormitory dining room. Only a few officers of SMA comprised the head table, and there were no guests to introduce, no "greetings," no speeches. The chairman made a few remarks and did announce the names and affiliations of the fifteen or so of us from other

countries who were attending the meeting. The excellent roast beef was accompanied by a choice of wines. Prior to the dinner, we were privileged to attend a get-together of the officers and guests of SMA for a "wee sherry." Here we were introduced to the Honorable Lord Boyd-Orr, Chancellor of the University and President of SMA. An eminent scientist, he is a former head of the Food and Agriculture Organization and a Nobel Peace Prize winner.

After the Association dinner, everyone reported to historic Bute Hall to hear Lord Boyd-Orr's presidential address, "Education for the Atomic Age." It was on this occasion that a departure from custom was made. The chairman again introduced and welcomed the visiting guests of SMA and then called on Robert H. Carleton (NSTA) to respond on behalf of all the foreign science teachers. After brief remarks, Mr. Carleton presented Lord Boyd-Orr with a mounted certificate of Honorary Life Membership in NSTA. This gesture proved to be more appropriate to the occasion than was anticipated because, as we shall see, the President of SMA really occupies an honorary position. In a sincere response, Lord Boyd-Orr said, "I accept this with personal pride and as symbolic of the strong ties between our Associations and of the important tasks ahead in international education which we must share to our fullest capacities in every possible manner."

An offering of tours and visits to laboratories rounded out the program with one exception, the Annual Business Meeting. Three of our delegation went on the field trip to the Marine Biological Station at Millport on the quaint, secluded Isle of Cumbrae. The day for this dawned beautifully clear and sunny, a welcome change after a week of dreary, miserable fog, rain, and snow. The journey to Millport consisted of an hour's train ride and a forty-minute ferry boat trip, the course of which took us close by the location of the new U.S. Polaris submarine base. Meanwhile, the other two NSTA delegates, as well as some of the other foreign visitors, visited a couple of schools and then attended a special reception in the Glasgow City Hall where they were officially received by the Lord Mayor.

The annual Business Meeting of SMA is conducted somewhat in the

manner of the annual meeting of the NSTA Board of Directors, except that all business was transacted in an hour and a half. The meeting was open and all SMA members were entitled to be present and vote. About 150 members attended the session. Here policy questions were decided and actions taken which became binding upon the Association. Several of the issues were of the kind that would be referred to the entire membership of NSTA for a vote by mail ballot. One action taken doubled the annual dues of SMA, raising the amount from one pound to two pounds (about \$6). Interestingly, a companion action now empowers the SMA Committee (comparable to our Board of Directors) to offer reduced fees to science teachers in other countries, the amount of dues for each country to be decided by the Committee. This action was closely related to another proposal, namely to increase SMA activities on an international scale. Dr. Henry F. Boulind, a science lecturer in the Department of Education at the University of Cambridge, is acting as Secretary for this work.

The governing body of SMA, the counterpart of the NSTA Board of Directors, is an elected Committee comprised of the Chairman (comparable to our President), four Secretaries, a Treasurer, an Editor, a Librarian, two Trustees, and ten Other Members some of whom represent defined districts (comparable to our regions). The SMA equivalent of our Executive Committee would be made up of the Chairman, the four Secretaries, and the Treasurer. Since it is the custom of SMA to hold its annual meeting at a college or a university, the official head of that institution, if willing, is elected President of SMA for the year ending with the meeting. Thus the 1961-62 President, elected at Glasgow, is Sir Patrick Linstead, Rector of the Imperial College, London, where the 1962 meeting will be held.


Much of the work of SMA is carried on by committees such as the Science and Education Committee, with its several Panels, or the Secondary Modern Schools Committee. Whereas NSTA has thirty-five or more committees on the book this year, the program of SMA is handled by about ten committees. Each committee prepares a careful annual report and these are published in the official journal, *School*

Science Review (strongly recommended to all U.S. science teachers). At Glasgow, galley copies of these reports were available so that interested members could read them prior to the Business Meeting. When the reports were introduced, a few questions were asked and answers given, then the motion to accept was made, seconded, and voted—all in a matter of not more than ten minutes. Similarly, the election of a new Chairman of the Committee, the re-election of the Secretaries and the Treasurer, and the filling of vacancies among Other Members on the Committee were accomplished in less than twenty minutes. The Committee itself (rather than a special Elections Committee as in NSTA) proposed candidates and there were a few nominations from the floor, some of the latter being elected rather than the Committee's candidates.

A gratifying agenda item was a pleasant short speech by the Chairman, Mr. E. W. Moore, recognizing the American delegation, expressing appreciation to NSTA and NSF for making our visit possible, and voicing the hope that more NSTA delegates will attend future SMA meetings. The resounding "Hear, hear's," stamping of feet, and pounding of fists on tables made one believe that the members fully approved.

Appreciations

The members of this first official NSTA international delegation hope that these efforts have been satisfactory and will prove fruitful. We deeply appreciate the honor and privilege of representing the Association. It seems more than notable that the entire project was conceived, approved, planned, financed, and launched in a span of about three weeks. Obviously, the assistance of many others made this possible, as well as a successful execution of the project. We extend particular deep appreciation and thanks to the officers of SMA; the NSTA Executive Committee; the National Science Foundation; Mr. Robert Morris of the British Embassy in Washington, D.C.; Dr. R. A. R. Tricker, Chief Science Inspector of the British Ministry of Education; and Mr. H. M. Lockett, annual meeting Secretary of SMA, whose sudden, untimely death within a week after our departure from London saddened our return.



AN NSTA COMMITTEE REPORT . . .

PART II

European Science Teacher Study Tour

JULY 20, 1960 TO AUGUST 10, 1960

UNTIL very recently, the activities of our Association have been confined entirely to the continental limits of the United States. While it is true that our headquarters in Washington is visited frequently by teachers of science and administrators from abroad, that we do have members in about forty-five countries, that our professional journal occasionally carries an article by an overseas member, and that one of the guest speakers at our last annual meeting was a British scientist, it is also true that our interest and participation in international activities as an Association has been passive and unenthusiastic compared to what other societies are doing.

This situation was changed abruptly in the summer of 1959 when Donald Decker, then President of NSTA, and

The tour group enjoys afternoon tea at Dulwich College in London.





The Prime Meridian at Greenwich captivates the interest of Madeline Kearns, as she lines up her view for a camera shot.



W. H. Dowdeswell, head of the science department at Winchester College, begins a discussion with NSTA members of the tour.

Robert Carleton, the Executive Secretary, conceived the idea of sponsoring a summer science tour for our members. Dr. A. Raskin describes this tour and some of the adventures of our Association in the field of international activities.

The discussions and planning of Decker and Carleton became a reality on July 19, 1960, when the members forming NSTA's 1960 European Science Teacher Study Tour boarded a BOAC jet at Idlewild Airport, New York City. The group consisted of sec-

ondary school teachers of general science, biology, chemistry, and physics; college teachers of science; two elementary school supervisors; a research chemist; and two other teachers making a total of 34.

The major purposes of the study tour were:

1. To establish and strengthen, through conferences and seminars, personal contacts with our colleagues and counterparts in other countries, and to explain some of our problems to them.

To this end, the tour participants met with groups of science teachers and other members of the educational fraternity in Edinburgh, Winchester, London, Cambridge, Oxford, Amsterdam, Bonn, Munich, Geneva, and Paris. The meetings in total were productive, and there were ample opportunities for the group to become familiar with the problems faced by science teachers in other countries, and occasionally to acquaint them with our methods of operation.

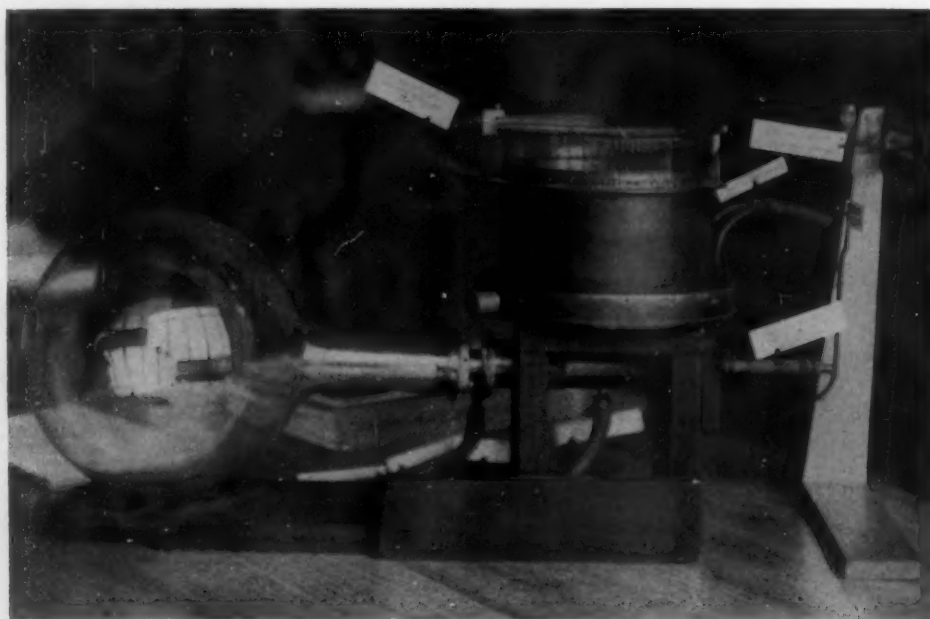
2. To visit primary and secondary schools, colleges, and universities with a view toward a study of facilities and other provisions for implementing the curriculum.

For this purpose, the tour members visited schools in Winchester, West Dulwich (near London), Munich, Geneva, and Paris, and universities in Cambridge, Oxford, and Edinburgh. Several of the schools we visited were extremely well-equipped and supplied with apparatus which would give them equal or superior rank with the best American secondary schools.

3. To visit and study places of special current and historical interest to teachers of science.

The group visited the Agricultural Research Council's Poultry Research Centre at Edinburgh, the radiotelescope at Jodrell Bank, the archaeological ruins of Stonehenge at Salisbury, the National Institute for Research in

The original Cloud Chamber of C. T. R. Wilson was viewed at Cavendish Laboratory, Cambridge University, England.



Nuclear Science of the Rutherford High Energy Laboratory and the Medical Research Council Unit at Harwell, the Science Museum in South Kensington in London, the National Maritime Museum at Greenwich, the History of Science Museum at Cambridge, the Floriade in Rotterdam, the Delta Plan and the Zuider Zee Reclamation Project in Holland, the Deutsches Museum in Munich, the Rhone Glacier and Mount Pilatus in Switzerland, the headquarters of the World Health Organization at Geneva, CERN (Center for European Nuclear Research) at Geneva, the Natural Sciences Department of UNESCO in Paris, the Pasteur Institute in Paris, and the Joliot-Curie Nuclear Energy Laboratories at the Centre d'Orsay near the city of Paris.

In addition, the group visited with several Americans who were teaching in Munich and Heidelberg; we had meetings with Dr. Ludwig Audreith, Scientific Attache of the American Embassy at Bonn, and with Mr. Vaughan DeLong, Consul General at Edinburgh. Members of the group attended performances of *The Merchant of Venice* at Stratford-on-Avon and *Der Rosenkavalier* at Salzburg. Many members of the group took advantage of their free time to visit local universities, museums, and other places of cultural interest. A formal part of the group's activity consisted of making coach orientation tours of many of the cities we visited. This was done in Edinburgh, Stratford-on-Avon, London,

The visit to the Zuider Zee polders begins with a briefing session. The land reclamation project in Holland of dikes and pumping stations serves to protect that area from the devastating storms of the North Sea.



The group visits a physics laboratory located at the Luitpold Oberrealschule in Munich, Germany.

Rotterdam, Amsterdam, Heidelberg, Munich, Berne, Geneva, and Paris. Other activities of the group included a Rhine River excursion and a visit to Rothenburg, a medieval walled city in Germany.

We presented bronze medallions with the official NSTA insignia to about twenty persons who had served as our hosts or guides, or in other special capacities along the way.

A comprehensive 96-page report (mimeographed) of the 1960 European Study Tour has just been issued by our Association and is available for interested readers. (See April *TST* page 57.)

The project would never have been completed without the full participation of the 32 individuals who had been willing to "sign up" for the tour. (The Assistant Director and Director of the tour included). They not only signed, they paid every penny of the cost themselves—there were no government subsidies, reduced fares, or other forms of financial support. Now it is true that those who paid had the fun; they visited six countries and had the wonderful times that go with "enduring the vicissitudes of travel with humor and good grace." But on the other hand, these 32 teacher tourists devoted nearly half of their non-traveling days to

professional conferences, school visits, and other specially planned science teaching-related activities. Moreover, they have prepared accounts of their visits, conferences, and other experiences, all of which are published as indicated above. For their participation and contributions, we are deeply indebted to all members of the 1960 Science Study Tour. Dr. Abe Raskin, Director of the Tour also prepared this summary and submits an outline of the daily tour schedule.

Visits to Places of Scientific Interest

- | | |
|---------|--|
| July 21 | Poultry Research Centre, Agricultural Research Council, Edinburgh, Scotland |
| July 22 | Radiotelescope, Jodrell Bank Experimental Station, Lower Withington, Cheshire, England |
| July 25 | Stonehenge, Amesbury, England |
| July 27 | National Institute for Research in Nuclear Science, Harwell, England |
| July 27 | Medical Research Council Unit, Harwell, England |
| July 28 | Science Museum, South Kensington, London, England |
| July 29 | National Maritime Museum, Greenwich, England |
| July 31 | Floriade, Rotterdam, The Netherlands |
| Aug. 1 | Delta Plan, The Netherlands |





Special coach orientation tours were arranged for the NSTA group.

- Aug. 3 Zuider Zee Reclamation Project, The Netherlands
- Aug. 12 Deutsches Museum, Munich, Germany
- Aug. 16 Rhone Glacier, Belvedere, Switzerland
- Aug. 16 Mount Pilatus, Lucerne, Switzerland
- Aug. 18 World Health Organization, Geneva, Switzerland
- Aug. 19 CENR (Center for European Nuclear Research), Meyrin, Switzerland
- Aug. 23 Pasteur Institute, Paris, France
- Aug. 25 Joliot-Curie Laboratories, Centre d'Orsay, France

Visits to Schools, Colleges, and Universities

- July 25 Science School, Winchester College, Winchester, England
- July 26 Kingsdale School, Alleyn Park, West Dulwich, London, England
- July 26 Dulwich College, West Dulwich, London, England
- July 27 University of Oxford
- July 30 University of Cambridge
- Aug. 11 Luitpold Oberrealschule, Munich, Germany
- Aug. 11 Ludwig Oberrealschule and Gymnasium, Munich, Germany

NOTE: The photographs of Edinburgh on page 10 and the one of Paris on page 21 were reprinted by permission of the NEA Travel Service Division.

- Aug. 19 College de Geneve, Geneva, Switzerland

Conferences and Seminars

- July 21 Scottish principal science teachers and headmaster, Edinburgh, Scotland
- July 26 Ministry of Education, London, England
- Aug. 3 Netherlands science educators, Amsterdam, The Netherlands
- Aug. 5 Permanent Conference of the Ministers of Culture, Bonn, Germany
- Aug. 11 State Ministry for Education and Culture, Munich, Germany
- Aug. 19 Swiss teachers of science, Geneva, Switzerland
- Aug. 23 UNESCO, Paris, France
- Aug. 25 Institut Pedagogique National, Paris, France

Other Activities

- July 19 Visit to the garden outside of Prestwick Airport
- July 20 Visit to the home of Consul General DeLong at Edinburgh, Scotland
- Aug. 6 Visit with the Science Attache, Dr. Ludwig Audrieth, at Bonn, Germany
- Aug. 7 Rhine River excursion
- Aug. 9 Visit to Rothenburg, Germany

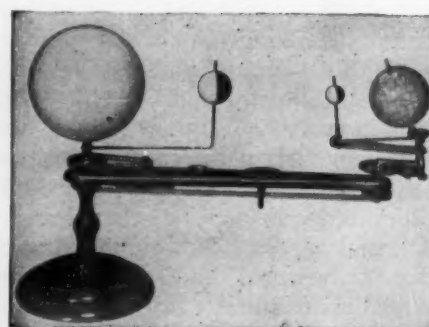
Astronomy Teaching Aids ★ ★ ★ ★ ★



De Luxe Celestial Globes

No. 740. Deluxe Celestial Globe. Our finest 16" globe was designed as a visual aid by teaching astronomers. All stars of the first six magnitudes are shown on a pale blue background, with the first three magnitudes having bright yellow circular backgrounds. Brighter stars named and constellation boundaries indicated. Declination and right ascension circles printed in black. Magellanic clouds and Milky Way stands out in white with other important star clusters indicated. Various models available. **\$67.50**

Trippensee Planetarium



No. 708. This demonstration device shows the relative position and motion of the Sun, Earth, Moon, and planet Venus. Simplifies teaching the rotation of the earth, the annual revolution around the Sun, day and night, change of seasons, and the mechanics of eclipses. This is an orrery-type device and not a projection planetarium. Constructed of brass with chain drive gears. Arm length is 16½", overall height 16". Hand operated. **\$96.50**

Science Associates, Inc. ★ ★ ★ ★ ★

Instruments/Weather • Astronomy/Teaching Aids

Write for complete catalog

P. O. Box 216

194 Nassau Street, Princeton, N. J.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Commander Alan B. Shepard describes the operation of the pressure suit worn during his flight.

THE National Science Teachers Association pays tribute to a scientific achievement of our era made possible through Project Mercury of the United States National Aeronautics and Space Administration.

Especially do we honor Commander Alan B. Shepard, Jr., of the United States Navy, and each of his astronaut colleagues.

As we witnessed the ceremony of the warm and joyous welcome accorded Commander Shepard and his fellow pilots by citizens in the nation's capital on Monday, May 8, it was unanimously agreed that a tribute to this epoch of scientific achievement should be recorded in our professional journal. With the last form of this issue of *TST* yet to be placed on the press,

Astronaut Shepard is acclaimed by 250,000 admirers as he rides to the United States Capitol to be received by Congress prior to the nationwide televised press interview relating to his flight. (Commander Shepard, waving to the crowd, is seated with his wife and Vice President Lyndon Johnson.)

WILLIAM E. MARKEY, PHOTOGRAPHER



A-OKAY

Tribute to Freedom 7, Alan B. Shepard, Jr.

the photographer was sent to the White House grounds to obtain photographs of Commander Shepard's visit.

Science teachers may rightfully claim a share of credit in pushing forward the frontiers of knowledge. Most of the new knowledge about space has been secured through the development and use of techniques and instruments which perhaps were considered "wild ideas" less than a decade ago. But the improvement of devices and research procedures grows out of man's basic knowledge, his ingenuity and courage, and his *curiosity* to probe fearlessly into the unknown, knowing full well that the more he probes, the more endless the frontier becomes.

Freedom to learn, to choose, and to act is an essential part of our heritage, and could not have been more ably demonstrated than by the recorded event of America's man-flight into space launched at Cape Canaveral on Friday, May 5, 1961.

With this evidence so strongly in view, we may well ponder the questions—How did this successful project begin? Where did the scientists, engineers, and technicians come from who made it possible?

Talk to a three-year-old child and you will soon discover within that in-

dividual a natural *curiosity*, an innate quality of the human mind. This curiosity in the field of science must be nurtured in the early years, even before the child enters school, if maximum potential is to be realized.

In this educational endeavor, the science teachers at all levels have a responsibility, not only to guide and encourage students in their choice of careers, but to demonstrate the intellectual challenge and the excitement of science in supporting our technological culture in the framework of a free society.

With the accelerated pace of technological developments, we cannot foresee the new frontiers which will be revealed tomorrow. But the role of the science teacher is clearly defined, and the record achievement of the "A-OKAY" astronaut might be shared by every classroom teacher who has had a part in developing a scientist, engineer, technician, or able student. It is "A-OKAY" to the efforts of the many dedicated and selfless teachers who are an integral part of the team in promoting the science progress of our nation.

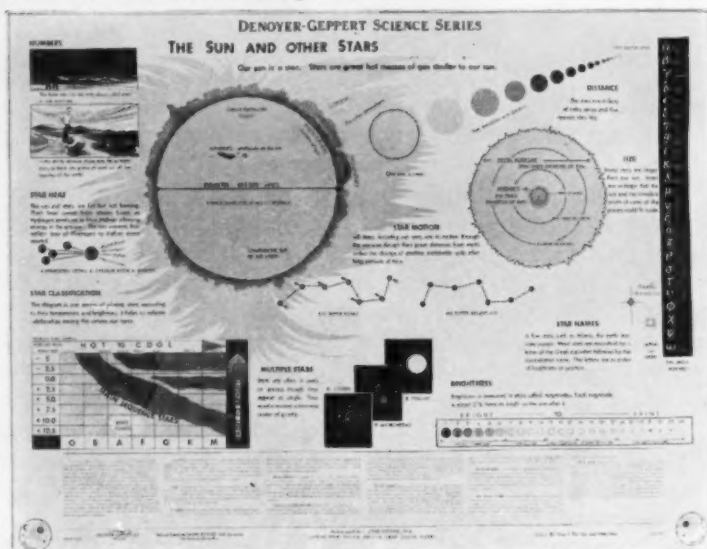
Commander Alan B. Shepard, Jr. was born November 18, 1923 in East Derry, New Hampshire. He attended primary school in East Derry and was graduated from Pinkerton School, Derry, in 1940. He studied at the Admiral Farragut Academy in New Jersey before entering the United States Naval Academy. In 1944, he graduated from Annapolis and in 1958 graduated from the Naval War College, Newport, Rhode Island. During World War II, the astronaut served on the destroyer *Cosgrove* in the Pacific. Later he entered flight training at Corpus Christi and Pensacola. Since receiving his wings in March 1947, he has taken part in numerous high-altitude tests and related flight experiments for the Navy. Prior to his selection as an astronaut for Project Mercury, he had 3600 hours of flying time with 1700 hours in jets.

New in plan, organization, purpose, content . . .

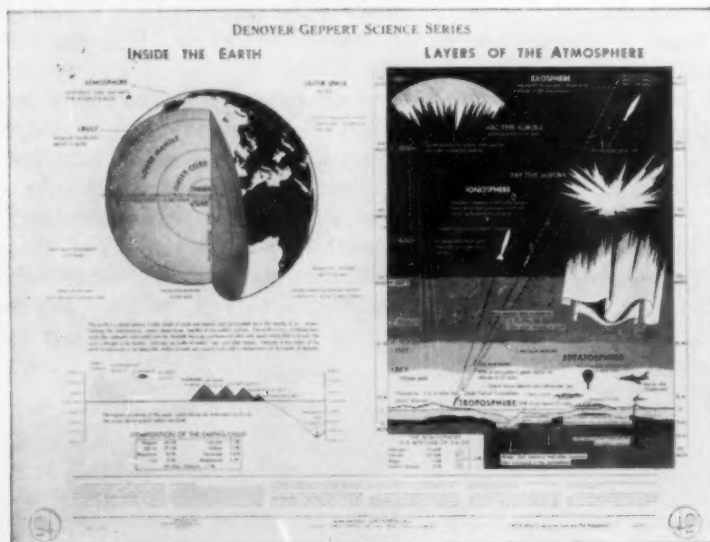
DENOYER-GEPPERT SCIENCE SERIES

COLORED RESOURCE CHARTS, EACH 54x44"

Editor and author: JOHN STERNIG, M.S., Asst. Superintendent of Schools, Glencoe, Ill. and Instructor in Science Teaching Methods, Lake Forest College.



DGSI.1-5 The Sun and Other Stars



DGSI.6 Inside the Earth and Layers of the Atmosphere

Sets of 12 Charts, per Set of Charts f.o.b. Chicago

- Mtg.—54 Set of 12 heavy paper charts, edges taped, in solid charthead on tripod.....\$ 40.75
- Mtg.—56d Set of 12 charts, handmounted on muslin, in solid charthead on disc base.....\$ 83.00
- Mtg.—16A Set of 12 removable charts, handmounted on muslin, on spring rollers in Simplex Case.....\$164.00
- Mtg.—32 Set of 12 charts on a single roller, base chart handmounted, others heavy paper.....\$ 68.75

For a description of the charts and for prices in various other mountings, send for Circulars S31a, S31b and S31c.

DENOYER-GEPPERT COMPANY

5235 Ravenswood Avenue

Chicago 40, Illinois

NOW READY!

Groups I, II and III

The charts are organized into five groups which together cover the entire field of science for elementary and junior high schools or beyond. Each group is composed of a number of charts all related to the main group title. In turn each chart is self contained with material developed around a title theme of its own.

DGSI The Science of Living Things

1. Life on Earth
2. Plants
3. Plant Classification
4. Animals
5. Animal Classification
6. Carbon-Oxygen-Nitrogen Cycles
7. Human Nervous System
8. Human Muscular and Skeletal Systems
9. Human Circulatory and Digestive Systems
10. Human Respiratory, Lymphatic and Endocrine Systems
11. Food
12. Health and Safety

DGSI The Science of the Earth

1. Picture History of the Earth
2. The Earth as a Sphere
3. Relationships of Earth and Sun
4. Maps
5. Time
6. Inside the Earth and Layers of the Atmosphere
7. Wind Systems of the Earth
8. Changing Surface of the Earth
9. Rocks and Minerals
10. Rocks and Soils
11. Water on the Earth
12. Conservation

DGSI The Science of the Universe

1. Space
2. Our Moon
3. The Solar System
4. Meteors and Comets
5. The Sun and Other Stars
6. Constellations I.
7. Constellations II.
8. Depths of Space
9. Astronomers at Work
10. Rockets and Satellites
11. Space Travel
12. Life in Other Worlds

Culture Media for Protozoa and Algae

The selection presented has been taken from one of a series of Culture Leaflets prepared by Ward's Natural Science Establishment, Inc. The methods for preparing controlled cultures are many and varied.

IN order to facilitate the study of living organisms in the laboratory, Culture Leaflet No. 5 was prepared to describe a series of culture solution concentrations that may be used immediately with the addition of the required amount of distilled water.

Dv 7—*Amoeba* Medium: For the culture of *Amoeba* and other Sarcodina. The medium as shipped consists of a concentrated salt solution that is highly recommended for the culture of various Sarcodina. This solution is to be diluted with the required amount of distilled water to make the number of milliliters required. After dilution, it is ready for immediate use. Depending upon the species to be cultured, either polished rice or boiled wheat grains should be added to the solution and the medium inoculated with the food organism (*Chilomonas*, *Colpoda*, or perhaps *Paramecium*) and finally the organism to be cultured.

For containers it is recommended that small 4½-inch diameter finger bowls be used. These should be stacked and the top bowl covered to avoid gross contaminants from the atmosphere. The rice or wheat grains should be added at the rate of four grains for each 200 ml of medium.

Dv 7.1—*Paramecium* Medium: For the culture of *P. multimicronucleatum*, *P. caudatum*, *P. aurelia*, and other ciliates. This set consists of a bottle of liquid medium that may be added to the required amount of distilled water to make the number of milliliters required. A small vial of boiled wheat grains and a small bottle of boiled timothy hay is included. These latter two portions may be held for some time under refrigeration without harm.

The medium may be placed in finger bowls, flasks, battery jars, or any suitable container. The addition of either wheat grains or timothy hay at inter-

vals will prolong the life of the culture. For a determination of the amount of wheat or hay to add for the species under culture, reference may be made to Culture Leaflet No. 1¹.

Dv 7.2—*Paramecium bursaria* Medium: Add the contents of the small bottle to 250 ml of distilled water in a 500-ml culture or Erlenmeyer flask. The medium is then ready for use, and the *Paramecium bursaria* may be added. Place the flask in diffuse light.

If it is desired to culture conjugating strains, use twice as much medium and mix in two flasks. Avoid contamination of the two strains by using separate pipettes for the examination of each.

Dv 7.3—*Volvox* Medium: For the culture of *Volvox* and related forms. This set consists of four numbered solutions 1, 2, 3, and 4 and one small vial. For 1000 ml of solution, take 900 ml of distilled water and add the solutions in order, mixing thoroughly after each addition. After the solution has been mixed, add the contents of the vial. A slight precipitate may appear in the solution. This precipitate does no harm to the algae and merely represents a slight excess of salt content.

Place cultures in a cool place with adequate illumination. A north window or fluorescent light fixture that can be placed from 6 to 18 inches away from the culture will suffice. For containers, finger bowls, battery jars, or any satisfactory, sterile vessels are recommended. Keep the culture covered or plugged to avoid contamination.

For 5000 ml of solution, take 4000 ml of distilled water and proceed.

Dv 2100—Basic Culture Solution: For the culture of many fresh-water algae. This set consists of 8 vials of nutrient solution consecutively numbered, one through eight. For one liter of solution, take 940 ml of distilled water, and for 5 liters of solution, take

4700 ml of distilled water. In either case, add in order the contents of the vials, numbered one through six, mixing well after each addition. Then add the contents of Vial No. 7 and Vial No. 8 in that order. Mix well, and the solution is ready for use. (Refer to Culture Leaflet No. 14.)

Series of Culture Leaflets

To date, Culture Leaflets Numbers 1 through 10, and Number 14 have been issued. As soon as Numbers 11, 12, and 13 are available, these will be distributed. A limited quantity is free to science teachers from Ward's Natural Science Establishment, Inc., P.O. Box 1712, Rochester, New York.

1. Culture of Protozoa in the Classroom.
2. Observations on the Feeding Reaction of Living Protozoa.
3. Use of Protozoa in Investigations of Cellular Structure.
4. Study of Living Protozoa by Use of Vital Stains.
6. Immobilization of the Living Protozoa.
7. Rearing Hydra in the Laboratory.
8. Culture of Planaria and other Worms.
9. Preparation of Media for *Drosophila* and Use of Mold Inhibitor.
10. Methods for the Culture of *Artemia*.
14. Culture of Algae in the Laboratory.

¹For a determination of the amount of wheat or hay to add for the species under Dv 7.1, see Culture Leaflet No. 1, *Culture of Protozoa in the Classroom*. For more specific methods for the culture of algae (Dv 2100), refer to Culture Leaflet No. 14, *Culture of Algae in the Laboratory*.

ACTIVITIES IN ASTRONOMY



By **ARTHUR G. SUHR**

Science Teacher, Jefferson High School, Jefferson, Wisconsin

This report was an entry in the 1960 STAR (Science Teacher Achievement Recognition) awards program conducted by NSTA and sponsored by the National Cancer Institute, U. S. Public Health Service.

THE study of astronomy in the average high school is given little emphasis. In this report the author suggests improvement in its presentation by supplementing the material included in the usual high school texts and workbooks with special activities. The demonstrations performed in this astronomy unit can be adapted to meet teaching situations in the general science program and can be used also in other subject areas.

Telescope and Solar Studies

Construction of a telescope was the largest project undertaken. With the assistance of one of the students, construction began of a four-inch reflecting

telescope. The component parts were mounted on a board so that the telescope construction and operation could be demonstrated in the classroom and set up for observation as well.¹ The assembly was completed in about six hours during class and in a few evening sessions working together.

Considerable time was spent in discussing the sun. This afforded an opportunity for several worthwhile experiments and demonstrations. For instance, the class may observe the sun for sunspots by projecting its image on a white poster board or screen with a pair of binoculars or a telescope. Many variations of this experiment are possible. The method used in this class was to clamp binoculars on a rod mounted on a standard tripod. The

image is best viewed when cast on a shadowed area of the screen. If this project is repeated for several days in succession, the relative positions and size of the spots can be observed each day. Where the spots are large and long-lived, it is possible to show that the sun turns on its axis.

The phenomenon known as the "Northern Lights" or *Aurora Borealis* serves as one example to introduce the study of the sun's radiations. The *Aurora* is formed in part from electrified particles emitted from the sun causing the rarefied atmosphere above the poles to glow. In a class demonstration, this phenomenon may be simulated with a vacuum discharge tube, a piece of apparatus available in many physics laboratories.² The influence of the earth's magnetic field on this glow was demonstrated by passing a horseshoe magnet over the vacuum tube and observing the deflection of the

¹ Parts for telescopes may be secured from many sources such as the Edmund Scientific Company, Barrington, New Jersey.

² C. L. Stong. "The Amateur Scientist." *Scientific American*, 194:132. February 1956; *loc. cit.*, 198:112. February 1958. National Academy of Sciences-National Research Council. *Planet Earth—Classroom Experiments*. Washington, D. C. 1958.

purple glow. These demonstrations are described in most physics textbooks.

The ultraviolet portion of the electromagnetic spectrum may be introduced at this time. This was demonstrated with fluorescence by using a General Electric Purple-X bulb as the ultraviolet source.³ Materials were obtained from advertising firms that use fluorescent inks for printing. The items were mounted on poster board and displayed in class.

Pendulum Project

A unique device for demonstrating the rotation of the earth on its axis is the Foucault pendulum⁴ which can be produced from an old shot-put. Suspension of the pendulum, the most important part of its performance, was accomplished by imbedding a hook in the metal shot, attaching it to piano wire, and allowing the assembly to hang from a bracket on the wall. The supporting wire was clamped between two pieces of angle iron welded to the underside of the bracket. (See Figure 1.) To insure accuracy, the pendulum must be completely motionless before the experiment begins. The bob was tied to one side of its natural arc by a string the night before the demonstration. At class time the next day, the pendulum was started in motion by burning the string. As the assembly began to swing, a large piece of poster board is placed under the pendulum. A circle is inscribed on it to mark off in degrees the measurement of rotation in a given period of time. A thorough explanation of the history and outcome of the experiment was necessary for an effective understanding of the demonstration.

Spectroscope Demonstration

The examination of the various spectra with a diffraction grating spectroscope is a student activity which answers the frequent question, "How do astronomers know what stars are made of?" The spectroscope⁵ may be constructed by the students themselves with the following materials: a card-

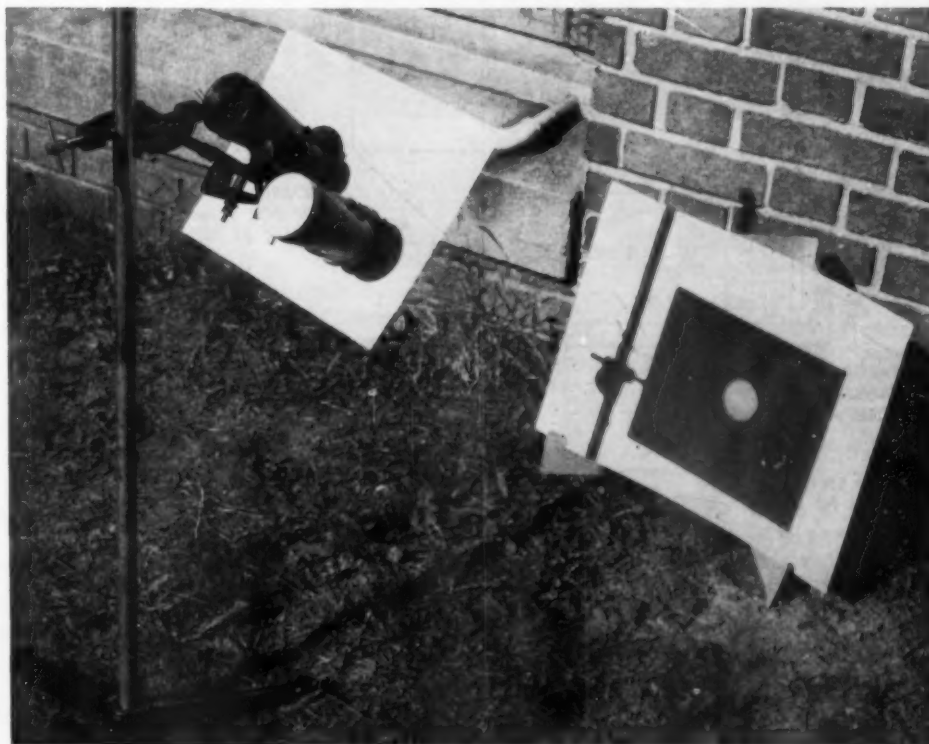
³ Available from the Welch Scientific Company, 1515 Sedgwick Street, Chicago 10, Illinois.

⁴ Richard M. Sutton. "Demonstration Experiments in Physics." McGraw-Hill Book Company, Inc., New York. 1938. p. 90; Thomas E. Thorpe, Jr. "Project Pendulum." *STAR '60 Selected Papers in Science Teaching*. National Science Teachers Association, Washington, D. C. 1960. p. 31; and Stong, *Op. cit.*, 198:115, June 1958.

⁵ Fletcher G. Watson. "Shoebox Spectroscope." *Tomorrow's Scientists*, 3:4, January 1959.



Four-inch reflecting telescope with its component parts mounted on a board was constructed by the author and his students.



Observation of sunspots is made possible by projecting the image of the sun on a white screen by means of a pair of binoculars clamped to a standard ringstand.

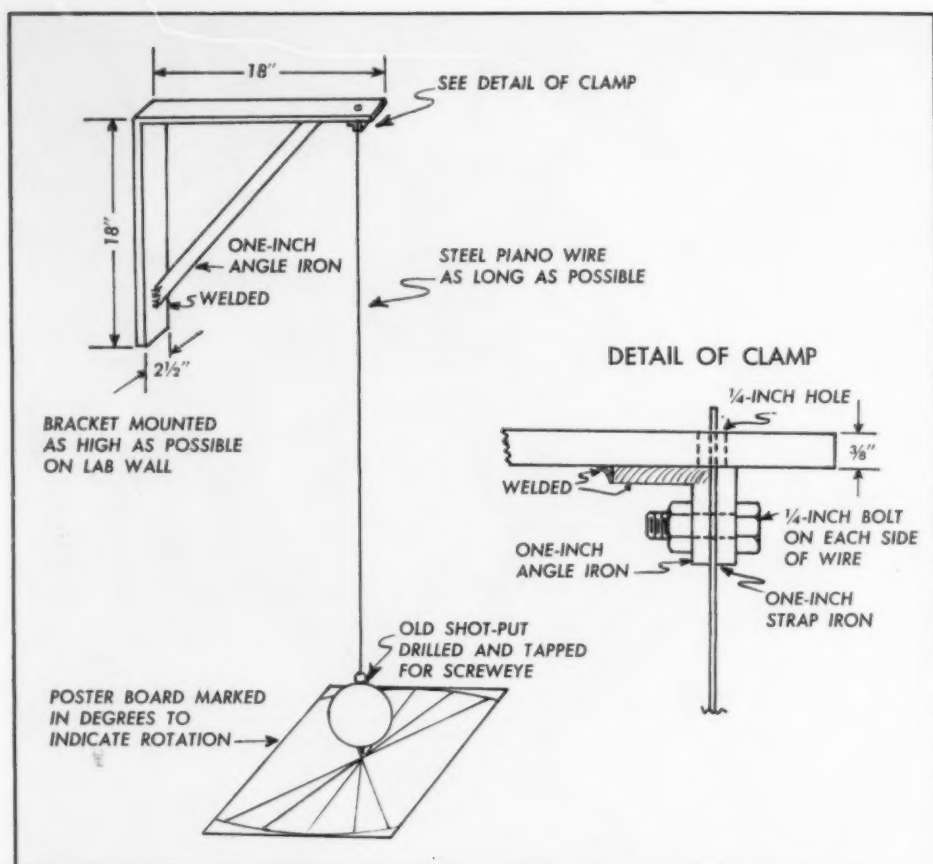


FIGURE 1. Detail of Foucault pendulum.

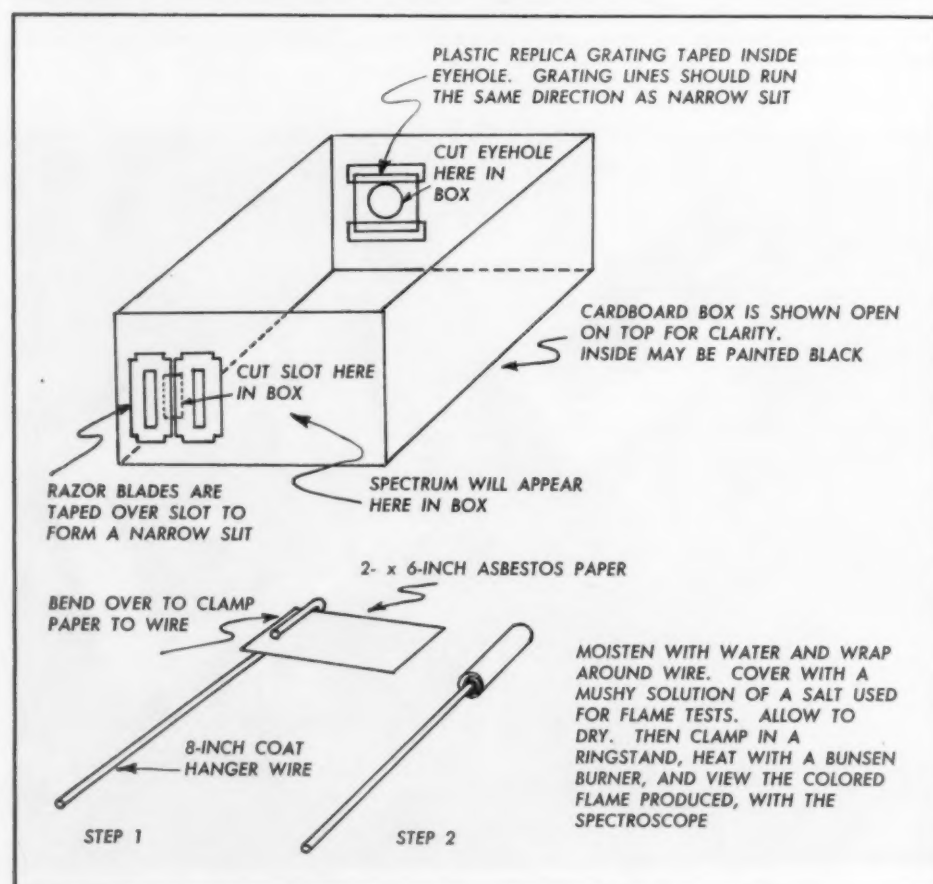


FIGURE 2. Detail of spectroscope and spectra sources.

board candy box, two razor blades, a replica diffraction grating, and Scotch tape.⁶ A slot about $\frac{1}{4}$ inch wide and 1 inch long was cut near an edge of the box. Two razor blades were taped over this slot so that their edges formed a narrow slit about $\frac{1}{2}$ to 1 mm wide. An eye hole, $\frac{3}{4}$ inches in diameter, was cut at the other end of the box, and a piece of the replica grating was taped inside this hole. The grating lines should run in the same direction as the slot. The spectra appear on either side of the slot when viewed through the eye hole. (See Figure 2.)

The spectra sources for this activity were produced from a piece of asbestos paper about 2 inches long by 6 inches wide clamped to a coat hanger wire about 8 inches long. The paper was moistened with water and wrapped around the wire. A mushy solution of each salt used in flame tests—sodium chloride, strontium chloride, etc.—was mixed, smeared over the asbestos paper, and allowed to dry. The specimen was then clamped to a ring stand and heated with a Bunsen burner.

The spectroscope may also be used to examine neon signs or fluorescent lights for a comparison of the spectra produced from these sources.

Time Measurement

Many texts mention the importance of time measurement in astronomy. The author supplemented the information in the textbook by the following method. Since the Bureau of Standards, Station WWV, and the Naval Observatory broadcast a continuous standard-time signal for the United States, the students were assigned to listen to this broadcast and determine its pattern in order to draw some conclusions. For this purpose, a short-wave receiver for signals of three wave lengths (2.5, 5, or 10 mc) was needed. The time broadcasts occurred at five-minute intervals with the first, second, and third minutes carrying a tone signal. Each second was denoted by a beep; the fifty-ninth second was omitted, and the sixtieth was indicated by a double beep. The announcer gave the standard time at the start of a tone signal before the end of five minutes. A new five-minute interval was begun, and the procedure then repeated.

⁶ Plastic replica grating is available from the Edmund Scientific Company, Barrington, New Jersey.

The above experiment may appear over-simplified, but it is useful.

Other Activities

In addition to the experiments and demonstrations described, students in the astronomy unit learned to photograph star trails⁷ and experiment with lenses and mirrors to determine how images are formed in a telescope. Through the use of simple thermocouples, an explanation was given as to how star temperatures may be calculated.

The author plans to expand the astronomy unit with some new activities involving "Measurement by Parallax,"⁸ "The Law of Equal Areas,"⁹ "A Pinhole Coronagraph,"¹⁰ and sun-spot photography.¹¹

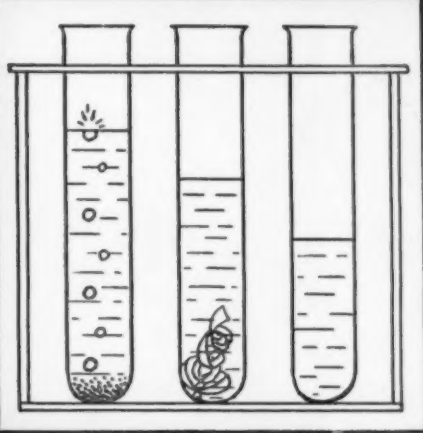
⁷ United Nations Educational, Scientific and Cultural Organization. *UNESCO Source Book for Science Teaching*. New York, 1956. p. 65.

⁸ Physical Science Study Committee. *Preliminary Edition of Laboratory Guide No. 2, Part 1*. Educational Services, Inc., Watertown, Massachusetts. August 29, 1958.

⁹ Physical Science Study Committee. *Preliminary Edition of Laboratory Guide No. 3, Part 1*. Educational Services, Inc., Watertown, Massachusetts. December 15, 1958.

¹⁰ National Academy of Sciences-National Research Council. *Planet Earth—Classroom Experiments*. Washington, D. C. 1958. p. 4.


¹¹ Robert W. Ferrell. "Sun Spot Photos." *Mechanix Illustrated*, 55:150. November 1959.



PROJECT

science demonstrations

IN COLOR
WITH MOTION
LIVE
AS THEY
HAPPEN



patents pending

The ACT-O-MATIC Dual-Position Projector enables you to project actual test tubes, electrolysis cells, meters and other science apparatus. As the demonstration is performed, it is projected LIVE on the screen in large, vivid detail. Also projects class notes, diagrams, etc. as they are written. Tested demonstrations and prepared transparencies are available in chemistry, physics and biology.

for additional
information
write to:

ACT-O-MATIC
DUAL-POSITION PROJECTOR

**LABORATORY
FURNITURE CO., INC.**
Old Country Road, Mineola, N.Y.

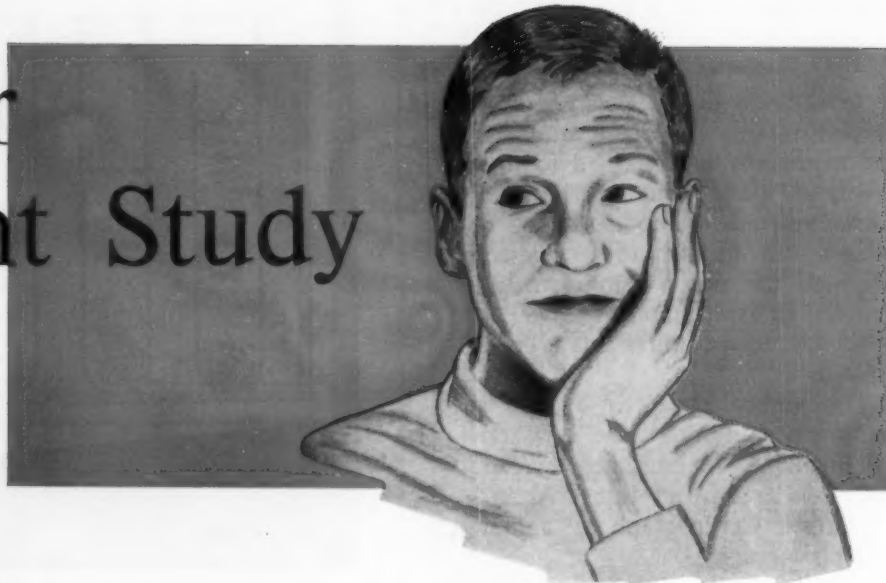
HARPER TORCHBOOKS

The Science Library

<p>W. H. Dowdeswell</p> <p>THE MECHANISM OF EVOLUTION</p> <p>Illus. 128 pp. TB/527 95¢</p>	<p>C. V. Durell</p> <p>READABLE RELATIVITY</p> <p>Foreword by Freeman J. Dyson</p> <p>160 pp. TB/530 \$1.25</p>	<p>Gottlob Frege</p> <p>THE FOUNDATIONS OF ARITHMETIC</p> <p><i>A Logico-mathematical Enquiry into the Concept of Number</i></p> <p>152 pp. TB/534 \$1.25</p>	<p>P. W. Bridgman</p> <p>THE NATURE OF THERMODYNAMICS</p> <p>256 pp. TB/537 \$1.50</p>
<p>P. M. Sheppard</p> <p>NATURAL SELECTION AND HEREDITY</p> <p>Illus. 212 pp. TB/528 \$1.35</p>	<p>Edmund Whittaker</p> <p>A HISTORY OF THE THEORIES OF AETHER AND ELECTRICITY</p> <p>Volume I: <i>The Classical Theories</i>. 448 pp. TB/531 \$1.95</p> <p>Volume II: <i>The Modern Theories</i>. 334 pp. TB/532 \$1.85</p>	<p>TURNING POINTS IN PHYSICS</p> <p><i>Essays by R. J. Blin-Stoyle, D. Ter Haar, K. Mendelssohn, G. Temple, F. Waismann, D. H. Wilkinson.</i></p> <p>Foreword by A. C. Crombie</p> <p>208 pp. TB/535 \$1.45</p>	<p>L. S. Stebbing</p> <p>A MODERN INTRODUCTION TO LOGIC</p> <p>544 pp. TB/538 \$2.75</p>
<p>J. E. Morton</p> <p>MOLLUSCS:</p> <p><i>An introduction to their Form and Function</i></p> <p>Illus. 240 pp. TB/529 \$1.40</p>	<p>Max Jammer</p> <p>CONCEPTS OF SPACE</p> <p><i>The History of Theories of Space in Physics.</i></p> <p>Foreword by Albert Einstein.</p> <p>224 pp. TB/533 \$1.40</p>	<p>David Bohm</p> <p>CAUSALITY AND CHANCE IN MODERN PHYSICS</p> <p>Foreword by Louis de Broglie</p> <p>192 pp. TB/536 \$1.35</p>	<p>A. Wolf</p> <p>A HISTORY OF SCIENCE TECHNOLOGY AND PHILOSOPHY IN THE EIGHTEENTH CENTURY</p> <p>Volume I: 172 illus. 416 pp. TB/539 \$2.50</p> <p>Volume II: 173 illus. 416 pp. TB/540 \$2.50</p>

For a complete catalog of Torchbooks (185 titles to date) please write Dept. 36 **HARPER & BROTHERS**, 49 E. 33 St., New York 16, New York

Criteria for Independent Study Projects



By DONALD WYNANT HUFFMIRE

Science Teacher, New Hartford Central School, New Hartford, New York

INDEPENDENT study is the pursuit of a special topic or project by the individual under the guidance of the teacher or other science educator as a part of the regular science course. It is not usually done in school. A project is a problem upon which a student works. It may require an empirical investigation. It may require doing an experiment, making a chart, making a model to illustrate a scientific principle, writing a report on a scientific article or book, or writing a report on a science topic of interest.

Science. The major project of the student should be in a scientific area. Science has many definitions. The authorities generally agree that science should be concerned with: (1) searching for knowledge or truth, (2) reflective, creative thinking about problems, (3) forming generalities from observations, empirically gathered evidence, and experiments, (4) using the inductive and deductive reasoning processes, (5) leading one to new concepts, experiments, and problems from each project solved. It is also concerned with methods of attack on problems, tactics and strategy by which problem solving and concept formation are carried out.

NOTE: Author is currently teaching earth science at North Syracuse Central School, North Syracuse, New York.

Educational and scientific objectives. Projects should help the teacher achieve the main objectives of science teaching. From the literature, it appears that educational objectives of science can be classified under these main headings:

1. To teach the different tactics and strategies of the scientist for solving problems and forming concepts.
2. To develop creativeness in students.
3. To provide for the individual growth of the student in knowledge, independent thinking, and self-direction.
4. To individualize instruction, thus helping each student develop in science to the utmost of his capacity and ability.

Students should be made to realize that there is no single scientific method, and that, in actual practice, scientists do not follow one particular method. They should learn to identify problems and solve them in order to form concepts.

Creativeness is the tendency of the individual to make novel adjustments. It is also the ability to synthesize previously unrelated elements of experience into a dynamic, unified whole. The authorities feel that all normal human beings have the capacity for creativeness.

Science instruction should make it possible for the individual to grow in knowledge, independent thinking, and self-direction. One of the most important objectives of science teaching is that the student should gain in knowledge. Individual thinking and the student's ability to plan and direct his own life are also important.

Since no two students are alike, there must be provision for the wide range of individual differences of all learners in their need and ability.

Evaluative Criteria for Science Projects

Student projects should be evaluated according to the objectives of science teaching. Unless one knows what to look for in a science project, evaluation is difficult.

Understanding the Tactics and Methods of the Scientist.

A scientific project should show that the student has used some of the tactics and strategies of the scientist in solving his problem and in forming new concepts. Some of the methods the student scientist could use are: (1) the planned investigation, (2) reflective thinking, (3) inspiration, (4) the "educated guess," (5) trial-and-error, (6) the chance discovery, and (7) reference to authority. The scientist may use some or all of these in his investigation.

The planned investigation. The planned investigation should include some or all of the stages of scientific inquiry. It might include some or all

of the following: observing nature or surroundings; describing and classifying data; recognizing a problem; using inductive logic to devise experiments and test hypotheses; making use of the control in an experiment; and using deductive logic when laws are discovered or assumed.

Reflective thinking. Reflective thinking may be used in many phases of the investigation. Reflective thinking is that kind of thinking which may appear when a problem arises that finds no ready solution. According to the literature, the student who is skillful in this kind of thinking can discover and clearly define problems. That is, he is curious, but does not try to solve problems for which there are no data; he differentiates between authoritative and nonauthoritative sources of information; he observes accurately in laboratory or field work; he shows discrimination in the selection of data and reasonably interprets the data; he selects the hypothesis which best explains the data; he reaches justifiable conclusions which do not claim too much or too little from the data; he is resourceful in attacking the problem and flexible enough to criticize his procedures at any point and to revise his tactics and strategy; he can formulate and carry out a plan of action even if it is based on inconclusive evidence and tentative judgments; he recognizes the possible existence of errors in measurement.

Inspiration. Associated with reflective thinking, another scientific method for attacking problems successfully is inspiration. There are five stages in this method. They are: preparation, incubation, intimation, illumination, and verification. During the preparation stage, the problem is investigated in all directions. In the second stage, there is no conscious thinking about the problem. Preceding the illumination stage, there is a moment when the individual realizes that the answer is coming. During the verification stage, the validity of the idea is reduced to exact forms by conscious use of discipline, attention and will.

The "educated guess." When a scientist uses an "educated guess" to solve a problem in an investigation, he is really playing a hunch. This method is used when there is no apparent solution to the problem. It is based upon knowledge about the prob-

lem. Muscular dystrophy and the Bohr theory of the atom were discovered by this method.

Trial-and-error. The trial-and-error method is used by the scientist when he does not have any clues for the solution of a problem. The scientist tries different procedures in attempting to solve the problem. It is usually a slow and unsatisfactory method. Though unscientific, it is still the method best suited for certain kinds of science problems. New antibiotics and quinine were discovered by this method. It is also being used in the fight against cancer.

Accidental discovery. New concepts may be discovered by the scientist accidentally. Some of these concepts led to the discovery of Uranus, the development of penicillin, the discovery of the cause of diabetes, and the discovery of X rays by Roentgen.

Reference to authority. The work of past investigators should be referred to during the investigation. Immediately upon starting the research, the young scientist must read as much about his area of investigation as possible. As he reads, the student should make observations and initiate experiments. However, it is not scientific to use library research as the only tactic in solving a problem.

Developing new concepts, problems. Any scientific investigation should result in the formation of new concepts and problems for the investigator to work on.

Using a logbook. One of the most important means of evaluating the student's tactics and strategy in problem solving is by analyzing his logbook. A scientist should make a record of all he does. He can never tell at the moment of observation whether some occurrence will later be important to his conclusions for the project.

Making a final written report. Since it is necessary that a scientist pass on his information to others, a written report should be included as a part of the science project.

Achievement of Creativeness.

Creativeness is important in all aspects of project work. According to the literature, formulating the hypothesis is the most creative aspect of research—whether the hypothesis relates to defining a problem, to determining a mode of attack, to establish-

ing categories for data, or to making deductions.

Other Kinds of Individual Growth for the Student.

In evaluating the individual growth of the student, such things as knowledge gained and grasp of the subject being studied, self-direction, independence of thinking, and the mental approach to the problem should be considered.

Through questioning, the student's understanding of the subject being investigated should be determined. He should have a good understanding of his particular field.

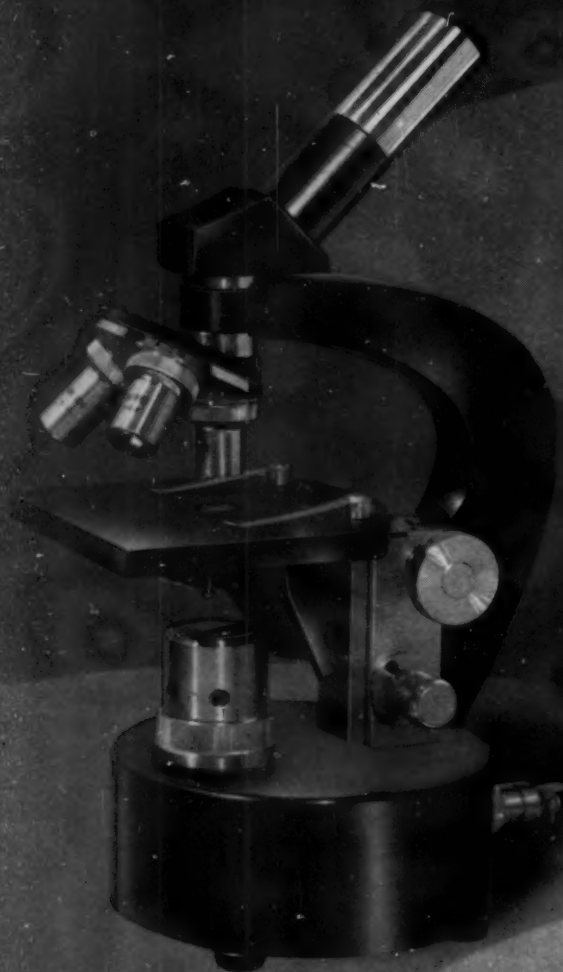
An important responsibility of education in a democracy is to promote the student's ability to plan and direct his own life. If while working on a project, a student has used his time efficiently, employed efficient work habits, mastered the necessary working skills or abilities, was not easily distracted, was neat, orderly, and thorough in his work, then he has demonstrated his capability for self-direction.

The student demonstrates independence in his project when he questions authority, not rebelliously, but in terms of the qualifications of that authority; when he discovers his own facts and hypotheses instead of being forced to depend on others for their thoughts; when he maintains reservations in accepting the conclusions of others until he has made his own investigations; when he maintains an open mind and is willing to change his opinions when confronted with new evidence; when he is tolerant of the opinions of others; when he is skeptical about his own generalizations and hypotheses and continually strives to substantiate them; and when he checks and rechecks the data in attempting to resolve any conflicting conclusions.

The literature indicates that in order for a person to succeed in science, he must have the proper mental qualities. Genius is not necessary. The attributes needed are clarity of mind, a combination of imagination and caution, of receptivity and skepticism, of patience and thoroughness, and of ability to finalize, of intellectual honesty, of a love of discovery of new knowledge and understanding, and of singleness of purpose.

To summarize, the evaluation of an

PLEASE ACCEPT OUR
Invitation
TO TRY
UNITRON
STUDENT MICROSCOPES
AT OUR EXPENSE



Ten minutes spent with any of these three UNITRON Student Microscopes will tell you more than we could say in ten thousand words. That's why we'd like to invite you to try one — or all three — for ten days . . . FREE. The only thing you have to invest is the next 5 minutes . . . to find out what's in store for you in top-notch performance and added advantages.

WHAT'S THE DIFFERENCE?

At first glance, the printed specifications on all student microscopes look the same. You might well ask "What's the difference — if any?" Here are the facts.

Even many of the largest manufacturers feel that optical and mechanical short cuts are quite acceptable in microscopes designed for the school or college laboratory. Therefore, they design their microscopes with lower-resolution objectives, without condensers, and often simplify mechanical construction. In contrast, UNITRON Student Models MUS, MSA, and MLEB are designed to give regular, professional performance, with no compromise in image quality.

THE LAWS OF OPTICS HOLD FOR STUDENT MODELS TOO

For a beginning student, any enlarged image seen through the microscope will appear exciting. But isn't it just as important to see a correct image? A true picture? Magnification without resolution is empty . . . the image appears blurred and details are fringed with diffraction lines in much the same way as a faulty TV picture. That's why UNITRON doesn't offer a 'student series' of objectives which, though named to imply "achromatic", still let color and aberrations in through the back door. All UNITRON Student Microscopes are equipped with the same professional-type objectives supplied on our more expensive medical models. Because our high-dry 40X objectives and condensers each have a numerical aperture of 0.65, the student can enjoy the same quality image at 400X or 600X that the medical student sees through his more expensive instrument.

WHY A CONDENSER? In microscopes using 'student series' objectives, the omission of a condenser may not be too serious, because there is really no high numerical aperture, or resolving power, to be realized. But all UNITRON Student Microscopes have a 0.65 N.A. condenser to utilize the high resolution of our professional quality objectives. We also provide an adjustable iris diaphragm (not merely a disc diaphragm) to control light reaching the condenser. All these extras work hand in hand with UNITRON's anti-reflection coated optics to produce an image of optimum contrast and clarity.

WHAT STAND DO YOU TAKE? Teachers and students want easy operation, durability and adaptability. And that's just what UNITRON Student Microscope Stands are designed to give. Positive and smooth coarse focusing is by a diagonal-cut rack and pinion. A simple counter-twist of the knobs gives easy tension adjustment to meet any preference. A separate and independent fine focus with full range of travel has a precision micrometer screw to assure sharp images.

Now — about the microscope stage. For precise movement of the specimen at 400X and higher, UNITRON offers a quick, easy way of attaching a reasonably priced mechanical stage. (Some manufacturers offer this feature — but only on their higher priced models.) All UNITRON Student Microscopes have stages pre-drilled and tapped to permit future addition of a precise, but inexpensive (\$14.75) mechanical stage. The large stage of Models MUS and MSA also acts as a bumper, projecting beyond the objectives and nosepiece to prevent accidental damage.

SOMETHING NEW HAS BEEN ADDED.

All UNITRON Student Microscopes now have built-in focusing stops that prevent accidental contact between the objective and specimen slide. This reduces repair costs for objectives and prevents slide breakage. Without the stop, it is easy for beginning students to pass through the critical point of focus, not even realize it, and ram the objective into the slide. The new stop also saves time and temper by automatically placing the image in approximate focus. Student guesswork is eliminated.

NEW 10X WIDE FIELD EYEPiece

Student microscopes are often chosen with at least two eyepieces, usually the Huygens type . . . a 5X for its large area of view, and a 10X for the magnification needed for critical observations. Now, our new coated 10X Wide Field eyepiece combines both these features in one eyepiece — a large field and the desirable 10X magnification. Teachers will like it: one eyepiece is more convenient than two. There's no chance for the extra one to become lost or damaged. And, it's slightly easier to use the Wide Field eyepiece because of its longer eye relief — you don't have to get your eye so close to the lens. Model MUS is now regularly supplied with this new eyepiece, but it's optional on Models MSA and MLEB, too.

ATTACHABLE SUBSTAGE ILLUMINATOR.

A snap-fit illuminator that attaches by means of the regular mirror mount, this new accessory eliminates any need for mirror adjustments or an outside light source. Even when the microscope is moved or inclined, the illuminator stays in alignment. It combines correct light intensity with convenience. Operates on regular 110-115V. current. The housing is rotatable 180° to give a choice of two types of illumination: bull's eye condenser for concentrated light or plane condenser for diffuse lighting. Built-in blue filters give daylight quality. Cost? — only \$10 as an accessory (less an allowance for the regular mirror if you don't need it.)

MEETS C.C.S.S.O. REQUIREMENTS... AND MORE.

UNITRON Student Microscopes more than meet the general requirements outlined in the Council of Chief State School Officers Purchase Guide. Our microscopes are available with either three or two objectives. Models with two objectives are supplied with a triple revolving nosepiece (with removable plug in the extra aperture) so that you can add another objective when you want it, without the extra expense of changing nosepieces.

CAN YOU AFFORD NOT TO BUY?

Check some of the prices listed in other suppliers' ads and literature . . . then look at ours. UNITRON saves you real money. And, if you're in the market for several instruments, new quantity discounts make our prices even lower . . . 10% for 5 to 10 and even higher discounts on larger quantities!

WHY NOT TRY ONE? If you are planning to buy microscopes, now or for your next budget, please accept our invitation to try one, or all three, UNITRON Student Models in your own laboratory, at our expense. Let UNITRON prove itself to you before you decide.



\$75 each

UNITRON STUDENT MICROSCOPE MODEL MUS

EYEPiece — Coated 10x Wide Field
OBJECTIVES — Achromatic coated 5x(10NA), 10x(25NA), 40x(65NA)
SUBSTAGE — .65NA condenser, iris and mirror
PRICE* — \$75 each (or \$67.50 each in lots of 5-10)

With two Huygens eyepieces — choice of 5x, 10x, 15x — price is \$74 each, (or \$66.00 each in lots of 5-10). Substage illuminator available in place of mirror or as accessory, at slight change in price.



\$107 each

UNITRON AUTO-ILLUMINATION MODEL MSA

EYEPieces — Coated Huygens 5x, 10x, 15x
OBJECTIVES — Achromatic coated 4x(10NA), 10x(25NA), 40x(65NA)
SUBSTAGE — .65NA condenser, iris, filter holder, built-in transformer and high intensity illuminator
PRICE* — \$107 each (or \$96.30 each in lots of 5-10)

With 10x Wide Field Eyepiece in place of three Huygens, MSA priced at \$103.50 each, (or \$93.15 each in lots of 5-10)



\$118 each

UNITRON STUDENT—LABORATORY MODEL MLEB (illustrated with optional illuminator)

EYEPieces — Coated Huygens 5x, 10x, 15x
OBJECTIVES — Achromatic coated 4x(10NA), 10x(25NA), 40x(65NA)
SUBSTAGE — .65NA condenser, iris, filter holder, and mirror
PRICE* — \$118 ea. . . . \$106.20 ea. in lots of 5-10

With 10x Wide Field Eyepiece in place of three Huygens, MLEB priced at \$114.50 each, (or \$103.05 each in lots of 5-10). Substage illuminator available in place of mirror or as an accessory at slight change in price.

UNITRON

INSTRUMENT COMPANY • MICROSCOPE SALES DIVISION
66 NEEDHAM ST., NEWTON HIGHLANDS 61, MASS.

☐ I accept (without cost or obligation) your invitation to try Model(s) _____ for 10 days.
☐ Please send UNITRON Microscope catalog # 8-P

NAME _____

SCHOOL OR COLLEGE _____

STREET _____

CITY _____ ZONE _____ STATE _____

*Free delivery to your school. Plastic dustcover, fitted wood case with handle and lock, are all included in prices shown. For information on other microscopes and accessories, send for free catalog — see coupon.

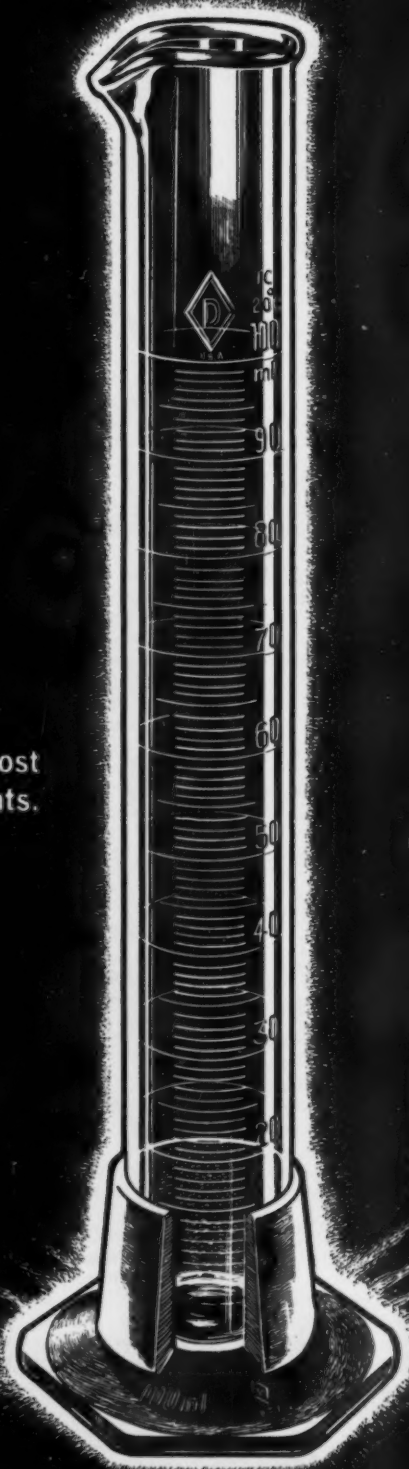
Announcing Our New



Detachable Plastic Base CYLINDER

TWO-WAY SAVINGS!

Save substantially on initial cost
and save on cost of replacements.



CHECK THESE LIST PRICES:

10 ml.....\$.80

25 ml.....\$.87

50 ml.....\$.99

100 ml.....\$1.28

Available only through Laboratory Supply Dealers.



DOERR GLASS COMPANY
VINELAND, NEW JERSEY

independent study project in science should be based upon the methods and tactics used, the creativeness expressed, and the individual growth of the student scientist.

Specifically, in evaluating the tactics used by the student scientist, it should be determined whether the tactics used were appropriate for the problem. Since no two problems are alike, no one method can be applied invariably to all problems.

Other things to consider in evaluating the tactics used are: (1) whether the problem was stated simply, clearly and concisely, (2) whether the investigation was planned well, (3) whether the investigation was carried out well, (4) whether the observations were empirically obtained by observations and experiments, (5) whether the observations were accurate, (6) whether the data were grouped and classified properly, (7) whether the hypotheses formed concerning the solution of the problem accounted for a fair part of the available information, since some of the data might be incorrect or irrelevant, (8) whether the apparatus was designed appropriately for the experiment, (9) whether the apparatus

works properly, (10) whether the student has tested each of his hypotheses and eliminated the ones which do not help to solve the problem, (11) whether he tested his ideas again and again, and checked them against the work of others, (12) whether objective measurements were used, for which the limits of accuracy were known by the student, and subjective measurement clearly described, (13) whether the observations and experiments can be verified, (14) whether the concepts formed from the data and from the solution of the problem were sound, and (15) whether new prob-

lems and experiments were suggested from the solution of his problem.

Creativeness should be evaluated by analyzing the student's logbook. It should be evaluated in terms of the manner by which the student's problem originated, how the hypotheses were formed, how the hypotheses were tested, how the data were collected, organized and interpreted, how the generalizations were drawn, how the apparatus was designed and improved, and how the conclusions were drawn and whether or not new concepts, experiments, and problems for future work resulted from the total effort.

Spring Science Titles from Columbia

Dr. Ernest Borek on biochemistry

THE ATOMS WITHIN US

A lively and literate discussion of the history, procedures, and accomplishments of biochemical exploration. The book is designed to serve as a general background for courses in biology and chemistry and is written in largely non-technical terms for advanced high-school and college level students. Price: \$5.00.

UNESCO on the racial question

RACE AND SCIENCE

A collection of studies by natural and social scientists participating in UNESCO's program on Race and Culture. Among the many subjects discussed are: the race concept, the significance of racial difference, the roots of prejudice, racial myths, and race in relation to society, culture, and history. Price: \$5.00.

René Dubos on science and society

DREAMS OF REASON

The relationship of science to modern society, explored in highly original terms. First presented as the George B. Pegram lectures at Brookhaven Laboratories, these essays show how philosophical and social assumptions, more than physical needs, influence the beliefs and activities of scientists. Published July 10. Price: \$5.00.

David Joravsky on science in Russia

SOVIET MARXISM AND NATURAL SCIENCE 1917-1932

This book examines Soviet Marxist philosophy of natural science as it developed in its first phase, from 1917 to 1932. The author reviews the arguments Soviet Marxists used in defining their philosophies of natural science. Price: \$7.50.

ALSO: **AIR POLLUTION:** Essays from the World Health Organization on current trends in air pollution research, \$10.00.

COLUMBIA UNIVERSITY PRESS

New York 27, N.Y.

USED AND APPROVED BY LEADING UNIVERSITIES

Model RV-6
**6-INCH
DYNASCOPE**
Reflecting
Telescope

includes
these features:

- Electric Drive
- Rotating Tube
- Setting Circles

Only

\$194⁹⁵

F.O.B.
Hartford

Finest American-made 6-inch reflector in its price range! Saves \$100 or more, yet get all these fine features. f/8 6-inch mirror accurate to 1/4 wave • 3 matched eyepieces (75X, 150X, 343X) • 6x30 Achromatic finderscope • Heavy duty mount with setting circles • Rack & Pinion eyepiece holder • Sturdy Tripod.

Completely
Portable!
Entire telescope
dismantles in
minutes for
easy carrying.

CRITERION MANUFACTURING COMPANY

Dept. THD-7 331 Church St., Hartford 1, Conn.

FREE FACTS! MAIL COUPON!

Criterion Manufacturing Company
Dept. THD-7, 331 Church St., Hartford 1, Conn.

☐ Under your unconditional guarantee, please ship me promptly the RV-6 DYNASCOPE. My payment of \$194.95 is enclosed.

☐ Please send FREE LITERATURE on the RV-6 Dynascope and your other DYNASCOPES priced as low as \$49.95.

Name.....
Address.....
City.....State.....

Classroom

IDEAS

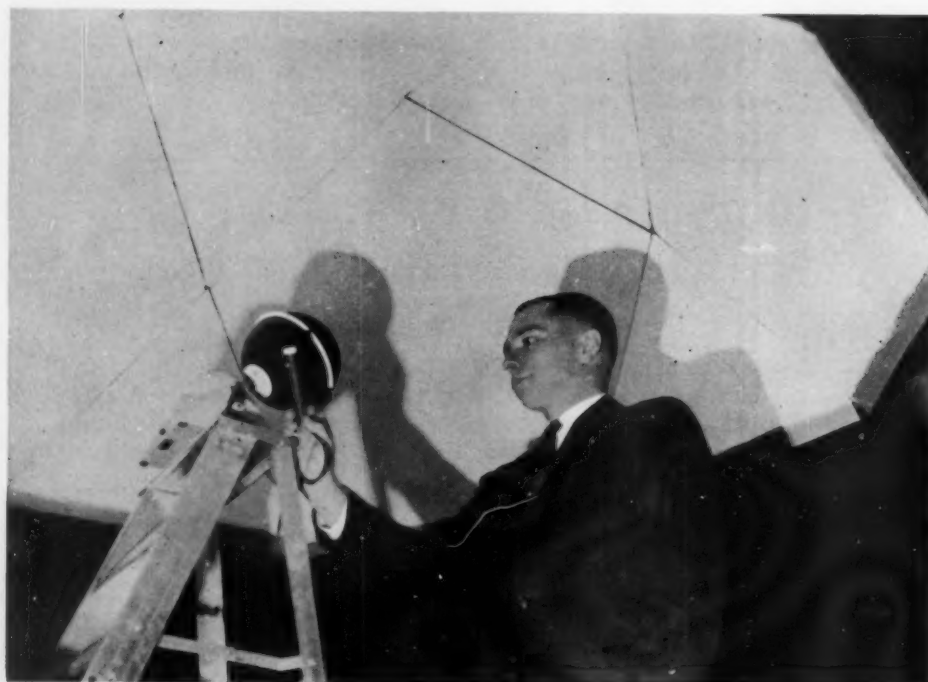


FIGURE 1. The dome, nearly hemispherical, provides about 6.5 square meters of projection area.

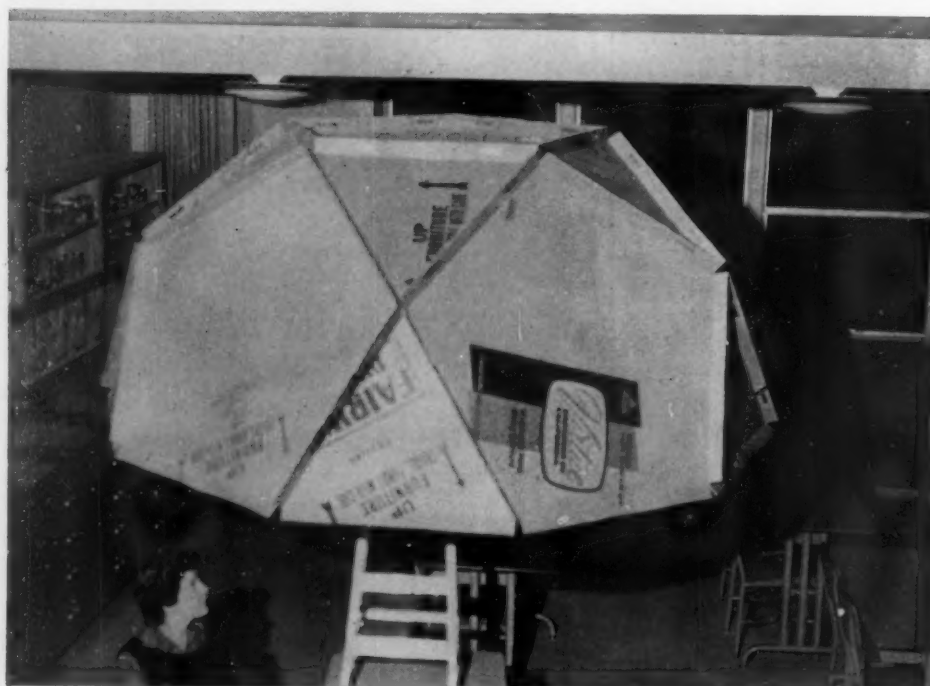


FIGURE 2. The structure incorporates ten triangles, making it rigid and lightweight.

General Science

An Inexpensive Planetarium Dome

By WILLIAM M. THWAITES, Walter Colton Junior High, Monterey, California

A planetarium dome can be built of corrugated cardboard at nominal cost and can be stored flatly during periods when not in use. This dome when used with a low cost commercially available star projector can provide an economical stimulus in the teaching of elementary astronomy.

The need for providing a stimulating experience in space science is made clear by daily newspaper headlines. A planetarium can provide a learning experience in some ways that surpass direct observation. Unfortunately few schools have been willing to put up with the expense and inconvenience of providing such an installation. Essentially any expense and many of the difficulties can be avoided with the combination suggested here.

The dome is intended for use with a low cost star projector available through toy stores, as well as through some scientific equipment companies. This projector cannot be used alone in a normal partially darkened classroom. A dome of some sort must be provided in order to make the star images clearly visible. In addition, the dome provides a realistic likeness to the celestial sphere observable in nature. (See Figure 1.)

The structure pictured here is about two meters in diameter and easily accommodates fifteen students plus the teacher. It has a semi-regular polyhedral shape requiring the use of six pentagons and ten triangles, one-half of an icosidodecahedron. (See Figure 2.) Each face is regular with all sides measuring sixty-five centimeters. The faces were flanged and fastened with Acco No. 22 paper fasteners. (See Figure 3.) The inside was painted with flat white paint to provide an optimum projecting surface and the entire structure was suspended by pulley from the ceiling. When the dome was not being used, it was quickly lifted out of the way. At the conclusion of the astronomy unit it was taken apart in a few minutes for storage.

This simple structure made it pos-



FIGURE 3. Flanging adds strength and a means of fastening the faces together.

sible to demonstrate not only identification of star groups, but also diurnal motion of the stars, celestial poles, celestial equator, meridian, zenith, horizon, latitude determination, and other spacial concepts normally impossible to demonstrate. Expense and inconvenience should not be deterring factors in providing this space experience in our space age.

Teacher-Made Slide Rule

By WILLIAM MacDONALD, Horace Mann Junior High School, Brandon, Florida

Have you avoided teaching use of the slide rule in class because you were unable to obtain some funds to purchase a demonstrator? Although many teachers are forced to omit this from their schedule, it does not solve the problem nor help increase the knowledge of the student. One way to solve the problem, however, is to construct a slide rule, and any teacher can do this in spite of limited funds.

First, procure three six-foot lengths of straight tongue-and-groove flooring. These should fit snugly together when interlocked. Lay these three pieces flat on the floor, side by side, loosely interlocking the tongues and grooves. This is necessary to permit free sliding. For supports, cut three strips of similar wood long enough to reach across the total width of the three boards. Nail these strips into the top and bottom boards at three uniform distances along the slide rule, allowing the middle board to slide freely. Some trimming of the tongues and grooves may be necessary to obtain free slippage. A carpenter's plane or pocket knife may be used for this purpose. Further ease of

movement may be obtained through the use of powdered graphite serving as a dry lubricant.

The final stage of the woodwork is to rip a six-inch length of flooring in half to slide above and below the rule and house the clear plastic indicator. Six by twelve inches is a desirable size for the plastic indicator which may be obtained from any hardware store. Screw the plastic indicator to the runners on either side.

Now, the frame is completed, and the whole rule should be painted with one or two coats of flat black paint. All that remains by this time is the

scaling. With an ordinary ruler, measure the distance between two major units on a ten-inch slide rule. Multiply that distance by six and lightly mark the result on the face of your slide rule. Continue this method until all major divisions are indicated on one scale of the rule. You will now have a sixty-inch face on the slide rule. The secondary digits may be added in a similar manner. The tertiary markings can be approximated. Paint points and numbers on the rule with white paint.

As many additional scales may be added to the rule as the teacher would like. The rule pictured, however, is

TIME

15 minute film

**A SCIENCE FILM DESIGNED
TO PORTRAY THE CONCEPTS OF**

- Scientific time determination
- Time-keeping
- Standard time zones
- Daylight savings time
- Greenwich time
- International date line

AN INDIANA UNIVERSITY PRODUCTION

*For rental, preview, or purchase
information write to:*

Audio-Visual Center
Indiana University
Bloomington, Indiana



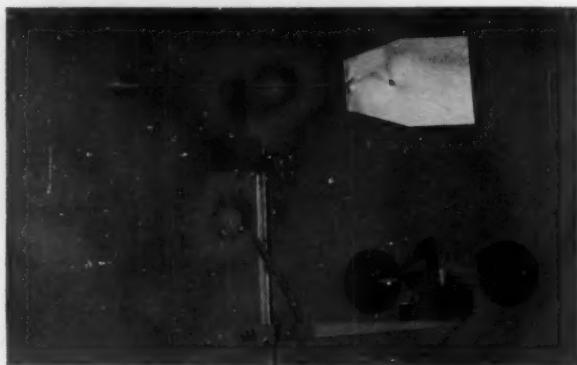
The Truly Portable

Classroom Science Table

CHECK THESE FEATURES

1. Full Size 48" x 24" chemically resistant top with safety metal edge flange.
2. Sturdy all metal base cabinet.
3. Easy-Roll Castors — Two Fixed and Two Swivel With Brakes for quick maneuverability and stability.
4. Large, two gallon, water supply in unbreakable bottle with easy operating long life marine pump—plus two gallon unbreakable waste collector bottle.
5. 10½" Stainless Steel Sink with Swing Spout.
6. Threaded Flush Plates For Support Rods.
7. Sectional Support Rods of plated steel—Threaded to assemble without tools. Disassemble into fifteen inch lengths for Convenient Storage in Drawer. (Six lengths and two clamps included with each table.)
8. Six Outlet Electric Supply with fuse, switch, indicator light and fifteen foot extension cord, U-Ground and adapter plug.
9. Safe Arrival and Satisfactory Performance Guaranteed.

No. 11-1 Complete.....\$248.00



Cambosco Weather Station

Designed to meet the need for precision equipment to measure and record the factors that make up "Weather", Cambosco now offers two units — the basic Weather Center for elementary study and the complete Weather Station for more advanced work.

The Weather Center (shown on left) includes:

- 1—Triple Scale Aneroid Barometer.....No. 67-305....\$51.50
- 1—Wind Velocity Meter.....No. 67-49 64.50
- 1—Wind Direction Indicator.....No. 67-50 84.50

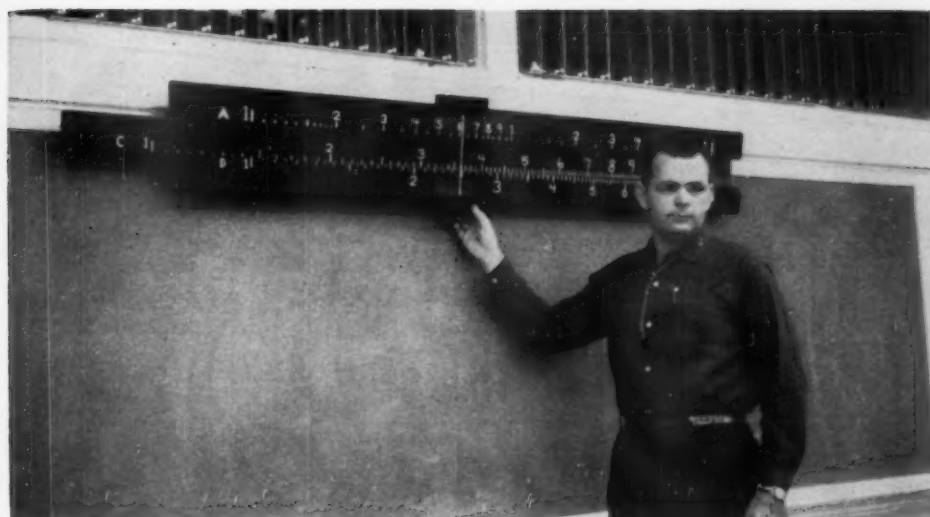
The Complete Weather Station including the above plus thermometer, rain gauge, hygrometer, recording temperature and barometric pressure instruments, psychrometerNo. 67-55....\$426.00

The safe arrival and satisfactory performance of all instruments is guaranteed by Cambosco.



CAMBOSCO SCIENTIFIC CO., INC.;

37 ANTWERP ST. • BRIGHTON STATION • BOSTON, MASS.



Author demonstrates the proper use of his constructed slide rule.

used at the eighth-grade level, and the writer preferred not to complicate it with scales that the average eighth grader would not comprehend. This rule can be used for multiplication, division, square root, and ratio and proportion.

The total cost of the rule was: Flooring—0.75; plastic—0.75; graphite from pencil sharpener (no cost); paint and miscellaneous expenses—0.35; or a total of \$1.85 for the materials. It took twelve hours of the teacher's time. But you have a demonstration tool that can be used throughout the year, and possibly for several years. This alone minimizes the time spent by the teacher on the project. It is not unlikely that your students could construct the rule with your help to cut down on even the twelve hours you might spend.

Chemistry

The Use of Unknowns

By T. W. JEFFRIES, Kelso High School,
Kelso, Washington

Frequently, the student parrots definitions of elements, mixtures, and compounds without understanding the differences which each exhibits. In an attempt to overcome this, the author has devised an unstructured laboratory experiment to point up the differences.

The student is told that in several weeks he will be given an envelope containing a substance which is a mixture, a compound, or an element. The actual

experiment is not introduced, however, until the basic laboratory techniques, such as filtering, bending tubing, etc., are completed. Only general information is given on procedures and references to be followed.

In a written report, the student is required to explain how he arrived at his decision. His grade is based on the laboratory results and whether he is able to make an identification. The highest grade is given for a correct answer with logical laboratory results. The next best grade is earned by an incorrect answer with good laboratory results. Finally, the lowest grade is assigned to an unsupported right answer or the wrong answer with the correct evidence.

In making the unknowns, the author attempted to choose mixtures that were homogeneous and would not give visual evidence. A suggested list might include: commercial fertilizer, baking soda, baking powder, calcium carbonate, colored chalk, colored chalk and sulfur, clay, sugar, salt, sugar and salt, carbon, manganese dioxide, carbon and manganese dioxide, anhydrous copper sulfate, cement, albumin, ferric oxide, ferric oxide and red phosphorus, or magnesium oxide and calcium carbonate. The varieties and combinations are inexhaustible.

The students entered into the spirit of investigation, and the results were most satisfactory. Although only a few obtained correct answers, all of the students seemed to have a better understanding of elements, mixtures, and compounds.

ANNOUNCING

The new CHILTON Basic Science Series

This major educational publishing project will make science and technology come alive for today's student and general reader. It will comprise a library of low-cost, vivid, lavishly illustrated pocket-size books by outstanding authors from all over the world. When complete, the series will cover the whole range of animate and inanimate nature, of man and his works.

- Each book 5" x 7", 256 pages
- Full-color illustrations in 50-50 ratio with text!
- Low price per volume; only \$3.50 cloth, \$2.50 paper
- 52 volumes now planned—at the rate of four or more each year.

THE FIRST VOLUME WILL
BE READY SHORTLY

THE HISTORY OF MAN

By Gustav Schenk

The series starts, appropriately, with a book about man—who created the whole structure of knowledge with which it deals. This book, by a noted German science writer, presents what we know today about man's nature, his origin, his development through prehistory and history—and what we can reasonably conjecture about his future. *The History of Man* is written in language that will be readily understood by the student or layman. And—like all the other volumes to come—it is profusely illustrated in color.

Cloth \$3.50
Paper \$2.50

Examination copies will gladly be supplied for your evaluation, billed on approval at your regular institutional discount.

CHILTON BOOKS

A division of Chilton Company
56TH AND CHESTNUT STREETS
PHILADELPHIA 39, PA.

CRAFTSMANSHIP

When you examine the Elgeet-Olympus Research Microscope, you will be impressed by the skilled craftsmanship inherent in each fine detail of its precision construction.

You will note such refinements as completely enclosed rack-and-pinion movements, safeguarding against wear-causing dust and dirt; the smooth, finger-tip response of the separate coarse and fine focusing controls, located together in the same convenient "Ready Region."

You will appreciate the matchless quality of its optical components—hard-coated, achromatic lenses throughout—for flawless image, brightness, contrast, and flatness of field throughout a full range of magnifications.

You will recognize the extended range of versatility, made possible by its ingenious design and useful accessories, the interchangeable monocular, binocular and trinocular inclined eyepieces, each of which rotates a continuous 360°.

Yet, for all its advanced features, dependable performance and durable construction, each model of the Elgeet-Olympus Research Microscope is priced to defy all comparison—truly, today's greatest microscope value, and worthy of your careful consideration.

Mail Coupon Today For Complete Information

Dept. ST-5, Elgeet Optical Co. Inc. • Scientific Instrument and Apparatus Division • 838 Smith Street • Rochester 6, N. Y.

- ☐ Please send me complete literature on the New Elgeet Olympus Microscopes.
☐ Please send name of Elgeet Dealer nearest me for free demonstration.

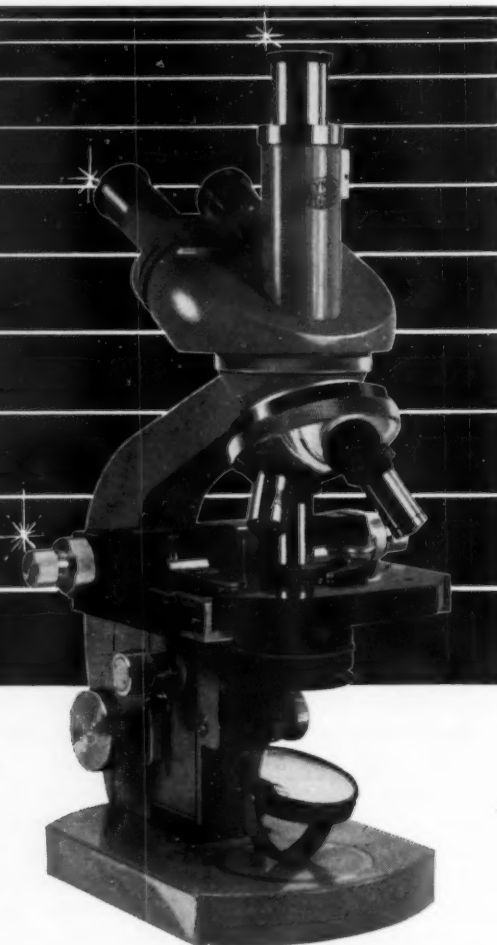
Name.....

Address.....

City.....State.....

Elgeet OPTICAL CO., INC. SCIENTIFIC INSTRUMENT AND APPARATUS DIVISION
 838 SMITH STREET • ROCHESTER 6, NEW YORK

"Quality is our watchword... Precision Engineering our constant goal."



Elgeet-OLYMPUS

Model ECTr

with the following features:

Inclined interchangeable trinocular body, rotatable through 360°, with interocular distance adjustable from 58 mm to 78 mm. Single P7X and P15X Periplane eyepieces. Single WF10X wide field eyepiece. Paired P7X and P15X eyepieces. Paired WF10X eyepieces. Triple revolving nosepiece with parfocal achromatic 10X (N.A. .25), 40X (N.A. .65), and 100X (N.A. 1.25) oil immersion objectives. Plano-concave mirror in fork mount. Comes complete with lock-tight fitted wooden carrying case. \$584.05 each. \$525.65 in lots of five.

Quadruple revolving nosepiece with additional parfocal achromatic 4X scanner objective is available for this model at small extra cost.

Write for information on other research models and complete microscope line.



NSTA Activities

Elections Report, 1961

Members of the Association gave support to six new candidates as more than 4200 ballots were cast in this year's election to choose two officers and four regional directors. The remaining officers and directors of the current Board complete the second year of their terms. (See 1960 elections, May TST.)

Returns were sent in promptly to the Headquarters Office by the Elections Chairman. Together with the Chairman, John P. Harville, we express our appreciation to the Committee and members for the excellent cooperation and interest and extend congratulations to the newly elected officers and directors who are listed below.

President-elect—John H. Marean, Reno High School, Reno, Nevada (1961-62; to serve as President 1962-63).

Finance Officer—Frederick R. Avis, Saint Mark's School, Southborough, Massachusetts (1961-63).

Region I. Director—Elizabeth Ann Quinn, Saxe Junior High School, New Canaan, Connecticut (1961-63).

Region III. Director—H. Craig Sipe, George Peabody College for Teachers, Nashville, Tennessee (1961-63).

Region V. Director—Walter E. Hauswald, Sycamore Community Schools, Sycamore, Illinois (1961-63).

Region VII. Director—Rodney F. Mansfield, State Department of Education, Denver, Colorado (1961-63).

Convention Notes

"Tremendous!!!"—that is the word for the NSTA Ninth Annual Convention at Chicago this year. The total registration reached 2710, which is nearly 900 more than the previous high established at Denver, Colorado in 1958. In addition, this represents a 50 per cent increase over last year's high in the number of commercial exhibits that were on display. There were a total of 148 booths in Chicago. The closed circuit TV, which operated 12 hours every day, proved to be a

successful innovation of interest to all participants.

With the program of the Chicago convention still fresh in our minds, we also remember the session of next year's committee members already at work planning the 1962 convention to be held at San Francisco, March 9-14. These alert observers of the committee even made use of the TV event to spot certain members and get them to sign their commitments. Leaders in the Bay area have set as their attendance goal a minimum of 2710 plus 1.

Chicago Convention Proceedings

The NSTA convention proceedings of the 1961 sessions will not be made available to the membership this year. The task of preparing these proceedings has generally been assigned to the membership in the field. The planning this year, however, did not include preparation of proceedings and we are, therefore, alerting you of this change.

Regional Conferences, 1961

Southeastern Meeting

Continuing a report on the series of regional conferences, NSTA will schedule the fourth at the University of North Carolina, Chapel Hill, on September 7-9, 1961. "Learning Science as an Individual Experience" will be the theme of this conference. Lectures and discussions will emphasize related processes and the role of the learner in the program. Small group discussions will be held in order to aid teachers, supervisors, and administrators to participate in an analysis of the individual problems in this area. The influence of current scientific emphases upon the learner, the effects of current teaching materials, problems of motivation, problems of the atypical learner, and the influence of community and national social scientific problems are examples of the range of topics to be included in the program.

Registration for the conference will begin on Thursday evening at 7:00 p.m.

THE PSSC PHYSICS FILMS

can help you teach



Dr. Jerrold R. Zacharias of MIT, who initiated the PSSC project, appears in a number of the films. He is shown here in "Pressure of Light."

These 16mm-sound motion pictures present concepts quickly and effectively. They are particularly helpful in introducing topics, enriching course material and showing difficult experiments.

Can you measure the speed of a rifle bullet in the lab? Take students out at night to find the speed of light? Films can show the experiments that must be done with materials too small, too large, too remote, too complicated or too expensive for the school laboratory.

PSSC physics films generate the kind of interest that opens young minds and motivates students. They bring to your classroom famous physicists in practical, realistic demonstrations. They give students a change of pace, a new approach and a new insight into the importance of physics today.

PSSC physics films correlate with all texts. 43 films have been completed. You may use the entire series or select as many titles as you wish. Correlation lists for standard textbooks are available on request.

Physics films developed by PSSC and produced by Educational Services Incorporated are easy to use. Modern Learning Aids makes them easy to obtain, too. They may be purchased with NEA funds, used on a subscription basis or acquired on a lease-to-buy arrangement. Under the subscription plan, you select titles and dates and have each film for three school days.

Modern Learning Aids has 31 film libraries in principal cities throughout the U. S. A. and in Toronto. Your films will be sent to you from the nearest film library.

NOW IS THE TIME TO PLAN FOR THE FALL TERM. SEND FOR COMPLETE INFORMATION TODAY.

MLA Modern Learning Aids

A Division of Modern Talking Picture Service, Inc.
3 East 54th Street, New York 22, N. Y.

Please send me complete information about the PSSC physics films, including all prices and correlations with standard textbooks.

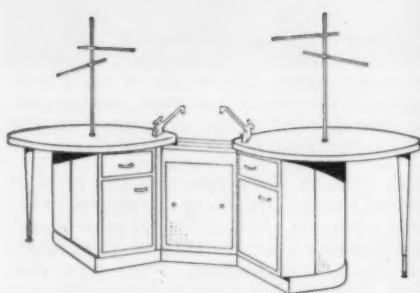
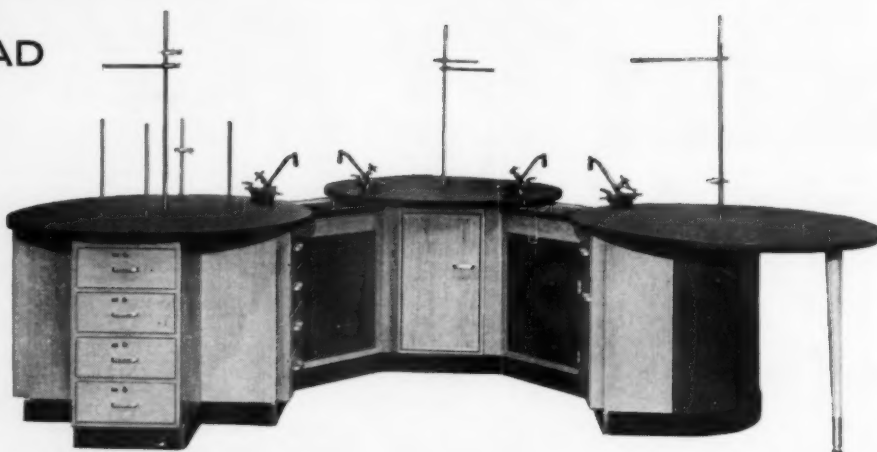
Name _____
Title _____
School _____
Address _____
City _____ Zone _____ State _____

19515

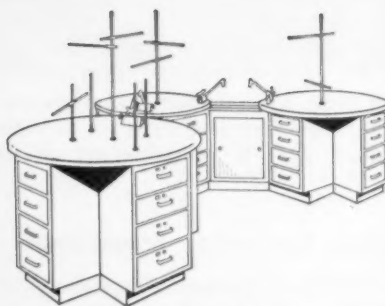
Science Circle®

A BOLD STEP AHEAD IN SCIENCE ROOM FURNITURE

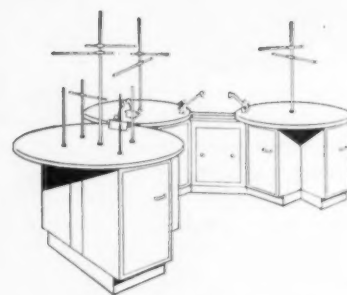
"Science Circle" Laboratory Furniture uses round tops, a choice of several storage bases, and interconnecting sinks to provide maximum work area at reasonable cost. Three types of base units are shown in this composite photo.



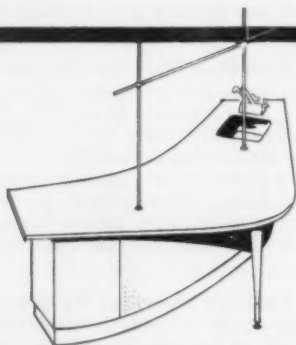
This eight-student arrangement for biology-physiics-general science consists of two four-student tables with one interconnecting sink. Each table has two No. 821-P base units and a standard leg unit.



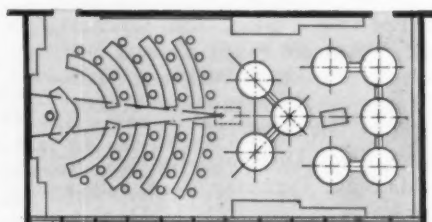
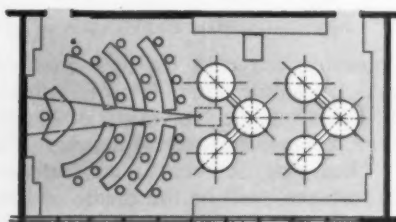
Twelve students can use this chemistry-physiics arrangement of three tables in triangular arrangement. Each table has four No. 822-P base units. The two sinks each have two cold water faucets, four gas cocks, and four duplex electrical outlets. These services are standard.



This arrangement is similar to the preceding twelve-student combination but uses three No. 692 "Station Issue" base units with two sinks. Services are standard as noted before. Ring rods shown on all illustrations are optional equipment.

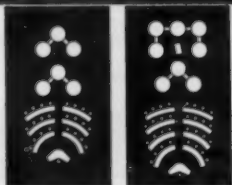


The No. 510 Instructor's Demonstration Desk is equipped with a sink, aluminum uprights and connecting rod. The desk shown has one No. 820-P base unit and one No. 822-P unit. Services include one cold and one hot water faucet, one gas cock, one duplex electrical outlet.



A wide variety of arrangements is possible with "Science Circle" Furniture. Here are two typical chemistry-physiics laboratories, one equipped for twenty-four students, and the other for thirty-two students. No. 630 Amphi-Lecture students' tables and a No. 510 demonstration desk are used in the lecture area.

For details, request Bulletin No. SC560.



Science Circle
LABORATORY FURNITURE BY
SJÖSTRÖM USA

JOHN E. SJÖSTRÖM COMPANY, INC., 1717 N. 10TH STREET, PHILADELPHIA 20, PA.

When you want the best—the very best

in Peabody Hall on the campus of the University. Following registration, a session planned especially for administrators and supervisors is scheduled. Commercial exhibits may be viewed on Thursday evening.

On September 8, Friday, registration with viewing of exhibits continues from 8:00 a.m. to 9:30 a.m. The opening session is to follow with the keynote address. After the twelve noon luncheon, special interest group sessions will be planned. The banquet is from 7:00 p.m. to 9:30 p.m. after which a planetarium show will be given.

On September 9, Saturday, registration and exhibits are open from 8:00 a.m. to 9:30 a.m. The general session to follow will be a symposium on "Helping the Elementary School Child Learn Science" and "Helping the Adolescent Learn Science."

Special group sessions begin at 11:00 a.m., followed by State group meetings to begin at 12:30 p.m.

For a final program and for room reservations, write to the Chairman, John B. Chase, Jr., School of Education, University of North Carolina, Chapel Hill, North Carolina.

Midwestern Meeting

The fifth NSTA Regional Conference will be held at the new Nebraska Center for Continuing Education, University of Nebraska Agriculture Campus, Lincoln, on September 22 and 23, 1961. With the co-sponsor, Teachers College of the University of Nebraska, we invite participation of all science teachers from Nebraska, Iowa, South Dakota, Wyoming, Colorado, Kansas, and other interested states. Focusing on three aspects of improving science instruction, the conference will cover (1) The Learner—Implications for Science Education, (2) The Subject—Science for Today's Children and Youth, and (3) The Teacher—Promising Practices in the Classroom and the Laboratory.

On Friday, September 22, early morning field trips will be scheduled concurrently with selected new science teaching films. The first general session will start at 10:30 a.m. with an address on youth as learners in science. This will be followed by a luncheon.

The second general session, after the luncheon, will include a speaker covering the topic of "children as learners in science." From these main topics, group discussions will be organized in separate sections. Concluding will be the banquet session that starts at 6:30 p.m.

Saturday, September 23, the sessions begin at 8:30 a.m. Two addresses are scheduled for this third general session. They will relate to the subject matter of science for use in the elementary school

and for the secondary school. Following this session, section meetings will be organized for elementary, biological, and physical science teachers. The noon-day luncheon will be devoted principally to NSTA Activities.

"Outlines of promising practices in the classroom and laboratory" will be the subject of the fourth general session. Discussions on specific teaching techniques and materials will bring the final session to a close. For further information write directly to the Chairman, James A. Rutledge, University High School, University of Nebraska, Lincoln 8.

Upper North Central Meeting

With "The Learner in Focus" as the theme for the sixth Regional Conference of the upper north central area, science teachers will have ample opportunity for a lively exchange in discussions of curriculum from kindergarten through grade twelve. To be held in Minneapolis, Minnesota, the three-day meeting will begin by registration on Thursday evening, September 28, 1961, at the Vocational High School Auditorium located at Twelfth Street South between Third and Fourth Avenues. Exhibits, teacher-planned programs of "Here-is-How-I-Do-It" demonstrations and discussions for classroom teachers of: early elementary learners (K-3), later elementary learners (4-6), junior high general science learners, biology learners, physics learners, and chemistry learners.

The sessions for Friday, September 29, and Saturday, September 30, will be devoted to presentations and discussions of some dynamic problems of "the learner" as an individual in our science classrooms.

Dr. Gordon Mork, educational psychologist and former high school science teacher, will focus our attention on the learner as an individual. He will describe how the learner acquires mental understandings and how we can teach him to think critically and creatively. Discussion groups will review examples of direct teaching in the light of Dr. Mork's presentation.

Dr. Ellsworth S. Obourn, science specialist with the United States Office of Education, will address the Conference on the topic, "Developing a Junior High School Science Program for the Learner." In his presentation, he will describe valuable junior high school science programs which are in use, promising directions which may be used in developing a dynamic science program, and learning activities which should be used to implement a new science program.

Dr. Milton Pella, professor of science education at the University of Wisconsin, will discuss and demonstrate to elementary teachers of science, "Developing Science Concepts with the Learner in the

FILMSTRIP PREVIEW -ING FASTER EASIER



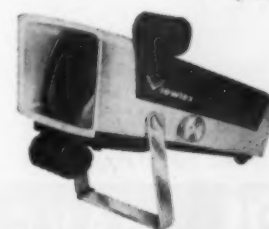
*Perfect in
Portability!
Seconds to
Set Up!*



iewlex Previewer Sr.

Fastest, most convenient method yet—for desktop previewing of 35mm filmstrips. Large 7" x 9" screen also provides ideal direct viewing for individuals or small groups and for home study or use as filmstrip "textbook." Threads itself instantly. Focuses with single knob.

Only
\$59.50



Previewer Jr.

For On-The-Spot hand-held or desk-top previewing of filmstrip. Operates on A.C. current or batteries. Simple to thread; sprocket advance. Extra-brilliant optical screen.

Model I—For operation on A.C. Current only **\$15.95**
Model II—For operation on A.C. Current and batteries **\$17.95**



Write for
Illustrated Catalog

iewlex INC.

8 BROADWAY, HOLBROOK, L. I., N. Y.

IN CANADA—Anglophoto Ltd., Montreal

A
science
program
that is
planned,
modern,
student-centered

GENERAL SCIENCE

YOU AND YOUR WORLD

Discoveries in Science (Workbook) • Teacher's Manual • Teaching Tests

YOU AND YOUR RESOURCES

Explorations in Science (Workbook) • Teacher's Manual • Teaching Tests

YOU AND SCIENCE

Experiences in Science (Workbook) • Teacher's Manual • Teaching Tests, Forms A and B • *Harbrace Filmstrips*

THE BIOLOGICAL SCIENCES

EXPLORING BIOLOGY: THE SCIENCE OF LIVING THINGS

Experiences in Biology (Workbook plus Laboratory Manual) • Teacher's Manual • Teaching Tests, Forms A and B

YOUR BIOLOGY

Teacher's Manual (Including Unit Tests)

YOUR HEALTH AND SAFETY

Teacher's Manual • Teaching Tests

LIFE GOES ON

THE SCIENTISTS SPEAK: BIOLOGY (a long-play record)

THE PHYSICAL SCIENCES

THE PHYSICAL WORLD: A COURSE IN PHYSICAL SCIENCE

Teacher's Manual • Teaching Tests

EXPLORING CHEMISTRY (In Preparation)

Laboratory Manual in Chemistry • *Experiences in Chemistry* (Workbook plus Laboratory Manual) • Teacher's Manual • Teaching Tests

EXPLORING PHYSICS

Laboratory Manual in Physics • *Experiences in Physics* (Workbook plus Laboratory manual) • Teaching Tests, Forms A and B

CHEMICAL CALCULATIONS (*Supplementary Book of Problems*)

PHYSICS CALCULATIONS (*Supplementary Book of Problems*)

A SPECIAL BOOK FOR THE STUDENT

HOW TO DO AN EXPERIMENT

SCIENCE TESTS

Stanford Achievement Test—Science Test (*Grades 7-9*) • Metropolitan Achievement Tests—Advanced Science Test (*Grades 7-9*) • *Read General Science Test* • Nelson Biology • Kilander Health Knowledge Test • Anderson Chemistry Test • Dunning Physics Test

BOOKS FOR THE TEACHER

TEACHING HIGH SCHOOL SCIENCE: A BOOK OF METHODS

TEACHING HIGH SCHOOL SCIENCE: A SOURCEBOOK FOR THE BIOLOGICAL SCIENCES

TEACHING HIGH SCHOOL SCIENCE: A SOURCEBOOK FOR THE PHYSICAL SCIENCES



HARCOURT, BRACE & WORLD, Inc.

A complete catalog is available from School Text Department offices in:

NEW YORK
CHICAGO
DALLAS
BURLINGAME

SCIENCE PROGRAM

TEXTBOOKS AND CORRELATED TEACHING AIDS FOR GRADES 7-12:

GENERAL SCIENCE

BIOLOGY

NONACADEMIC BIOLOGY

HEALTH EDUCATION

PHYSICAL SCIENCE

PHYSICS

METHODS TEXTS AND SOURCEBOOKS FOR TEACHERS

Elementary School." Dr. Pella will explain the directions which elementary school science programs, K-6, are taking, and during his workshop will suggest ways in which the elementary teacher can help the learner.

At the Friday evening banquet (September 30) we will have the privilege of hearing Captain Joe Kittenger of the Air Research and Development Command, who will bring the latest information on projects, "Man High" and "Mercury." Many will remember the event of last year in which Kittenger parachuted from a balloon at 84,000 feet.

Exhibits by manufacturers of science equipment and publishers will be open for inspection from Thursday evening through Saturday noon.

Classroom teachers of science from kindergarten through grade twelve, and supervisors, are invited and urged to attend this three-day Conference. It is for the benefit of all interested teachers; but especially for the teaching personnel in North Dakota and South Dakota, Iowa, Wisconsin, Minnesota, Illinois, and our Canadian neighbors in the Provinces of Manitoba and Western Ontario. Mark the dates *now* and initiate a request to attend the Conference through your principal and superintendent. The registration fee is \$2.

For further information and advanced registration write J. Hervey Shutts, Chairman, Upper North Central Regional Conference, Minneapolis Public Schools, 807 N.E. Broadway, Minneapolis 13, Minnesota.

International Activities

Youth Science Study Tour

The five student members of NSTA's delegation to Great Britain have been selected. They will attend the 1961 International Youth Science Fortnight to be held in London July 21-August 4 (see *TST* for March, p. 43 and for April, p. 57). These students, along with some 600 others from 15 different countries, will take part in an extensive program of addresses, panels, visits, and other activities arranged by the Worldfriends of Great Britain with cooperation of the British Association for the Advancement of Science. Each of the U.S. students has been awarded a \$350 stipend by Scholastic Magazines, Inc., to help defray costs. Following the London conference, the NSTA group, including their leader, Dr. Millard Harmon, will visit places of special scientific interest in the Netherlands, West Germany, Switzerland, and France. They will travel in a Ford station wagon provided through the courtesy of the International Staff of the Ford Motor Company. Upon returning to the United States, various members of the group will report

their experiences through articles in *The Science Teacher*, *Science World*, *Student Life*, and other youth publications.



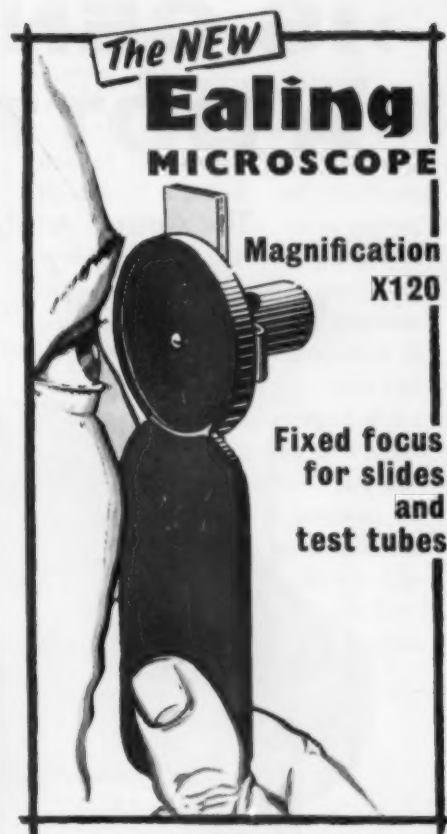
Chris Cherniak is sixteen years old, lives in Eau Gallie, Florida, and is in the eleventh grade (in upper ten per cent of his class) of Melbourne High School. Particularly interested in neurophysiology,

Chris has already studied advanced placement biology and Physical Science Study Committee physics and was vice president of the Florida Junior Academy of Science. His father is a guided-missiles engineer. Chris plays the clarinet, loves to swim and sail, and is now studying Russian and has had two years of Latin.

Joyce Meyer, daughter of a Colorado farmer, is a sixteen-year-old junior from College High School, Greeley, Colorado. Besides being a leader in many school, church, and local activities, she is Teen Talk Editor of the *Colorado Rancher and Farmer*. Through this medium, she plans to write a column about her international experience with other young scientists. One of her ambitions is to speak next year to the Colorado-Wyoming Junior Academy of Science. Her interest for science began in the field of entomology. Her "Study of the Ant" won an award at the Weld County Science Fair. In addition, she has been honored with second place and two champion awards at the 4-H Junior Fair. Joyce hopes to continue her studies in biological sciences through college and into research.



Edward G. Fisher, III, of Golden, Colorado is a seventeen-year-old science student in the eleventh grade at Golden High School. He is an active member of many science groups with special interests in physics (now enrolled in PSSC course), mathematics, and rocketry. Through his father, a professor of English at the Colorado School of Mines, Edward has become acquainted with students from abroad and shows an active interest in other cultures. He has been to



Wide assortment of prepared slides priced less than $\frac{1}{2}$ what you are now paying.

Students can prepare their own slides swiftly and simply for only 3 cents each.

Best of all a special test tube costing only 6 cents allows the individual, slow penetrating study of pond life and brings a fresh sense of discovery to the classroom.

Bring YOUR students a big, important step closer to nature.

The price of \$1.95 per Microscope permits individual student use — fifty sets can be had for one conventional instrument.

Send for descriptive booklet — or better yet order a sample set of Microscope, slides and test tube for only \$2.00 postage paid.

THE Ealing CORPORATION

33 University Road,
Cambridge 38, Massachusetts

IS CENTRIFUGING A BOTTLENECK?

The Adams Analytical Centrifuge,
with its "2 to 4 Student" capacity,
eliminates student "waiting time,"
solves your space problem



SAVES VALUABLE TIME... With 1 machine for every 2 to 4 students, there is little lost "waiting time."

Relatively high fixed speed (3400 RPM) and angle-head efficiency reduce time required for individual procedures.

Fast stopping, with light pressure of hand.

SAVES VALUABLE SPACE... Compact (10" in diameter) machine requires minimum of table space.

Light and portable—weighs only 11 3/4 lbs.

This six-place centrifuge (for 5 ml. or smaller tubes) is ideally suited for teaching elementary and analytical chemistry, including qualitative analysis. In the industrial laboratory, its speed and variable capacities recommend its use for micro & semi-micro work.

Economically priced, strongly constructed with a chemical-resistant finish, the Adams Analytical Centrifuge is maintenance-free...oilite bearings need no lubrication for 2 years. Brushless, sparkless motor eliminates fire hazard. 110-115 volt, 60 cycle, AC motor (transformer for 220 volt available).

Complete with angle-head, six shields and cushions, and six 5 ml. ungraduated taper bottom glass tubes \$69.00

ATTRACTIVE QUANTITY DISCOUNTS... Order from your supplier, or write Clay-Adams, Inc., 141 East 25 St., New York 10, N.Y.

Clay-Adams
NEW YORK 10

Canada and Mexico. His hobbies include reading, photography, and sports, especially swimming. Edward looks to a career in science or engineering. He has set his goal to complete a Doctorate.



Sheila L. Grinnell, 16, of New York City, attends The Bronx High School of Science. She is an outstanding student (ranks highest in her junior class) and has worked on a number of science projects.

These included work on a device to measure plant metabolism, co-author of articles, *Arista* tutor in chemistry, and lecturer before the Association of Mathematics Teachers on new concepts in geometry. One of her future goals is to present modern concepts of ancient geometry to her colleagues. Sheila is a member of the elementary and advanced chemistry clubs, of the Forum, and the Student Organization Art Publicity Committee. Her activities as a Girl Scout have given her opportunities to exchange views with her international counterparts. She says: "I hope to enlighten and, in turn, be taught by the world's young scientists."

Charles K. Holloway is a sixteen-year-old junior from Castlemont High School in Oakland, California. He has been enrolled in the honors program for the top two per cent of the students in his class since junior high school and has consistently demonstrated his outstanding abilities especially in general biology, chemistry, genetics, and embryology-ecology. He is a member of the Gifted Life Science Class, the school ROTC band, concert band, orchestra, and a member and manager of the school swimming team. His science project, "Production of Polypeptides from Inorganic Material," received first place at the Oakland Science Fair and second place at the San Francisco Bay Area Science Fair. The son of a United States Navy Surgeon, Charles is well acquainted with travel and peoples of many countries and has developed a keen interest in foreign affairs. He hopes to continue his studies in college.

Staff Changes

Margaret J. McKibben has joined the staff of the Instructional Services and Organization Division of the U. S. Office

of Education as an Assistant Specialist for Secondary Science. Her responsibilities will include participation in the research program in secondary school science, preparation of service leaflets and bulletins, and professional consultation.

During the past three years Dr. McKibben held the position of Assistant Executive Secretary for Special Projects of NSTA. She also served as Editor of the *Elementary School Science Bulletin* and was Director of the study, "New Developments in High School Science Teaching," published in 1960 by NSTA. Prior to her NSTA position, she was a teacher of biology at the Oak Park and River Forest High School, Illinois. Dr. McKibben completed her graduate work in biology and education at the University of Pittsburgh. Congratulations and best wishes go along to Dr. McKibben from the staff in this new endeavor!

Publications

Under the Publications Section which produces *The Science Teacher* and other NSTA publications, two newly assigned staff assistants have reported. Miss Phyllis Rose Marcuccio is the newly appointed Editorial Assistant, who comes to us from the New York City area where she had extensive experience in the graphic arts and production procedures related to magazine publishing. Oriented in the biological sciences, she served as Production Associate for a number of medical publications. A graduate of Bucknell University, Lewisburg, Pennsylvania, Miss Marcuccio received her AB Degree in art and biology.

Mrs. Jacqueline A. Fish, who was replaced by Miss Marcuccio, has left the Association and is happily celebrating the arrival of her first baby.

Mrs. Ruth Gunther, the new publications secretary, has had experience in various fields including medical and academic backgrounds. In the latter, she assisted with the editorial work of a secondary school publication for four years. Mrs. Gunther fills the position vacated by Miss Justine Burton who has assumed her new assignment with "Vistas of Science."

BEST SELLER EDITION!

Planning for Excellence in High School Science is a special NSTA publication aimed to assist teachers in analyzing and projecting for science education. It provides suggestions for basic policy directives to teachers, supervisors, administrators, and all concerned with curriculum development in science. 68p. \$1. (Discounts on quantity orders.) Send orders to NEA, Publications-Sales Section, 1201 Sixteenth Street, N.W., Washington 6, D.C.

ATTENTION . . . NSTA Conventioneers

The Food and Drug Administration of the U. S. Department of Health, Education, and Welfare, Division of Public Information, Washington 25, D.C., reports loss in the mails of signed requests for publications from science teachers attending the NSTA convention at Chicago in March. If you were one of these persons who stopped at the Exhibit Booth No. 118 and filled out a request to receive FDA materials, please send a postcard directly to FDA at the location above with your name and address. The FDA offer included a Science Convention Pack with free materials.



As a regular feature of *The Science Teacher*, the calendar will list meetings or events of interest to science teachers which are national or regional in scope. Send your dates to *TST*'s calendar editor as early as possible.

June 22-24, 1961: NSTA Regional Conference, University of Hawaii, Honolulu

July 7-9, 1961: Annual Business Meeting of Board of Directors, NEA Building, Washington, D. C.

August 25-26, 1961: NSTA Regional Conference, University of Utah, Salt Lake City

September 4-5, 1961: NSTA Regional Conference, Oklahoma State University, Stillwater

September 8-9, 1961: NSTA Regional Conference, University of North Carolina, Chapel Hill

September 22-23, 1961: NSTA Regional Conference, University of Nebraska, Lincoln

September 28-30, 1961: NSTA Regional Conference, Vocational High School, Minneapolis, Minnesota

October 6-7, 1961: NSTA Regional Conference, Bradford Hotel, Boston, Massachusetts

October 13-14, 1961: NSTA Regional Conference, Sheraton Hotel, Portland, Oregon

October 20-21, 1961: NSTA Regional Conference, Netherland Hilton Hotel, Cincinnati, Ohio

EDMUND CLASSROOM AIDS for SCIENCE TEACHERS

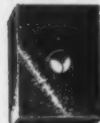
Order by Stock No.—Send Check or M.O.—Money-Back Guarantee . . . Write for FREE CATALOG "SC"

CENTRIFUGAL FORCE APPARATUS

When a ball is rotated at a given distance away from the center of rotation, the energy or centrifugal force that is created will support a weight greater than the weight of the spinning ball. The faster the speed of rotation the greater the weight that will be supported. This centrifugal force apparatus was developed by the Traveling Science Teachers at the Oak Ridge Institute of Nuclear Studies. The apparatus consists of a light rubber ball attached to a cord, with a weight load at the other end. The ratio of the weight of the ball and the weight load is 1 to 16. A Copper handhold is on the cord for use when the apparatus is being demonstrated. Instructions included.



Stock No. 70,381-SC.....\$3.00 Postpaid

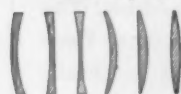


MAGNETS Ceramic Type—Only 5c Each in Quantity

Strong, durable Magnets $\frac{3}{4}$ " x 1" x $\frac{1}{4}$ " thick with $\frac{1}{8}$ " hole in center. Excellent for classroom distribution. Also use for making magnetic visual aids . . . use on magnetic chalk boards, etc.

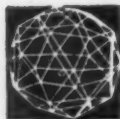
Stock No. 40,428-SC.....Package of 12—\$1.00 Postpaid
Stock No. 60,142-SC.....Package of 100—\$5.00 Postpaid

LENSES, DEMONSTRATION SET, NDEA Approved



Lenses have many uses in science programs where light is studied. This set is listed under the National Defense Education Act for elementary science, general science and physics. It is usable in classroom or for individual work. Consists of a plano-concave, convex-concave, double concave, concave-convex and a plano-convex, all six lenses are 50mm in diameter.

Stock No. 40,414-SC.....\$5.00 Postpaid



D-STIX CONSTRUCTION KITS

Colored wood sticks $\frac{1}{8}$ " thick and "easy-on" rubber joints approx. $\frac{1}{4}$ " diam. fit together quickly to form all kinds of simple or complex shapes, structures. Ideal for teaching mathematics, chemistry, physics, design, engineering, architecture, abstract art.

Stock No. 70,209-SC (230 pcs).....\$3.00 Postpaid
Stock No. 70,210-SC (370 pcs).....\$5.00 Postpaid
Stock No. 70,211-SC (452 pcs).....\$7.00 Postpaid

NEW! GRAPH RUBBER STAMP



Real time and labor saver for math teachers. If your tests require graph backgrounds—no need to attach separate sheets of graph paper and worry about keeping them straight. Simply stamp a graph pattern, 3" square as needed on each paper. Grading graph problems then becomes 100% easier. Stamps are 3" square overall—2 different patterns.

Stock No. 50,255-SC (100 blocks).....\$3.00 Postpaid
Stock No. 50,351-SC (16 blocks).....\$3.00 Postpaid

Polar Coordinate Graph Stamp—3" Diam.

Stock No. 50,359-SC.....\$3.00 Postpaid

COMPACT TESLA COIL

Safe. Spectacular. Demonstrates high frequency electrical current—Tesla's theory of power transmission. Light fluorescent tubes by placing near coil. Produce electrical pinwheels of sparks, etc. Unit includes coil, base, high tension capacitors, inductive coil, adjustable spark gap and cord. Complete manual included. Size 6" x 6", weight 8 lbs. Completely safe.



Stock No. 70,301-SC.....\$36.70 Postpaid

RIPPLE TANK

Simplifies Teaching of Wave Motion of Light—One-piece, leak-proof tank is made of optically transparent plastic with a clear water area 20" x 20" . . . 1 $\frac{1}{4}$ " deep. The rigid wood frame comes in two identical units, the bottom frame receiving the water tank and the upper frame holding a rigid, translucent plastic projection screen. A clear bulb placed beneath the tank provides illumination for projection. Mechanism is actuated by an eccentric fastened directly to the small motor shaft. Wave vibrations are transmitted to the water surface through a leaf spring supported rod, to give parallel wave front or point source agitation with the supplementary attachment which is included. Motor is operated by two flashlight batteries in a brass case with a sturdy rheostat to vary the speed.



Stock No. 85,064-SC.....\$49.50 f.o.b.
(Shipping weight 35 lbs.) Barrington, N. J.

Order by Stock No.—Send Check or M.O.

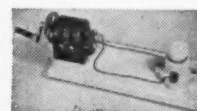
Satisfaction Guaranteed!

GYROSTAT

The apparatus used by Foucault to prove the Earth's rotation. Demonstrates principles of inertial guidance, gyroscopic inertia, ideal "learning-aid" for the space minded. Consists of inner wheel and frame 3" in diameter of super-impact styrene and outer frame 4" in diameter of aluminum of 1- $\frac{3}{4}$ " base. Overall height: 5". String, for spinning, and directions included.



Stock No. 70,401-SC.....\$12.00 Postpaid



ELECTRICITY DEMONSTRATION UNIT

For classroom experiments, demonstrations. Simple, dramatic way to show how electrical circuit is set up and how energy produces electricity. Three-magnet generator comes mounted on 4" x 10" wooden base with standard lamp receptacle and 7 $\frac{1}{2}$ watt bulb. Unloaded, unit produces 120 volts— or 60 volts across the 7 $\frac{1}{2}$ watt bulb included. Each of the 3 steel magnets is 2" high, faces are $\frac{1}{2}$ " x $\frac{3}{8}$ ". Generator is 4 $\frac{1}{4}$ " long x 3 $\frac{1}{4}$ " tall.

Stock No. 50,365-SC.....\$9.95 Postpaid



ANALOG COMPUTER KIT

Ideal introduction to the increasingly important electronic computer field. For bright students, or anyone interested in this new science. Demonstrates basic analog computing principles—can be used for multiplications, division, powers, roots, log. operations, trig problems, physics, formulae, electricity and magnetism problems. Easily assembled with screwdriver and pliers. Operates on 2 flashlight batteries. Electric meter and 3 potentiometers are mounted on die-cut box. Answer is indicated on dial. Computer is 20" long, 9" wide, 2" deep.

Stock No. 70,341-SC.....\$14.95 Postpaid



WORLD-TIME INSTRUCTIVE

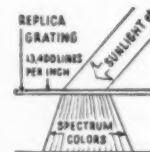
Why do we have differences in time occurring simultaneously at different points around the world? Why must we have an international date line to adjust these differences? Teachers who have found their classes have difficulty understanding the answers to these questions will discover that the WORLD-TIME INSTRUCTIVE is a valuable teaching device. The logic of world time is made visual and lucid even to the slower student when a demonstration is given with this new instructive. The impact is much greater than when only a globe is used for the explanation. Printed on durable laminated sheets that can be easily wiped clean.

Stock No. 60,140-SC.....\$3.00 Postpaid

REPLICA GRATING Take Color Photos At Night!

Use it for making spectroscopes, for experiments, as a fascinating novelty. Cheap enough that you can pass a piece out to each student. Produces beautiful view of spectrum. Comes in clear plastic protector.

Stock No. 50,202-SC includes 2 pieces 8" x 5 $\frac{1}{2}$ "—
1 transmission type, 1 reflecting type....\$2.00 Postpaid



NEW! JUST OFF PRESS! Write for FREE EDUCATIONAL CATALOG—"SC"

96 Pages . . . New, Useful Instructives

Dozens of new devices for teaching science, mathematics, astronomy, physics, etc. Scores of new kits and materials for Science Fair and other science projects! That's what you'll find in Edmund's new 96-page Educational Catalog for 1961. It's literally packed with new and exclusive math-and-science concepts developed by Edmund Scientific Co. and now available to schools for the first time.

Look at the partial listing of its fascinating contents: low-cost models for teaching basic mechanical and physical principles; actual working models of communication devices that can be set up, taken apart, and reassembled by students; a whole line of new science kits to spark science projects requiring real thought and initiative on the student's part; instruments and materials for such diversified activities as soil testing, spectroscopy, and harnessing solar energy. These and many more stimulating new instructives make this unique science materials catalog essential to forward-looking teachers on all grade levels.

Edmund's well-known values in science equipment—telescopes, microscopes, optical materials, and many other school requirements—are also included in this Catalog. For standard values and exciting new offerings, write for Edmund's 1961 Educational Catalog—"SC".

ORDER BY STOCK NUMBER . . . SEND CHECK OR MONEY ORDER . . . SATISFACTION GUARANTEED!

EDMUND SCIENTIFIC CO. BARRINGTON, NEW JERSEY

Physics for the Inquiring Mind. Eric M. Rogers. 778p. \$8.50. Princeton University Press, Princeton, N. J. 1960.

The purpose of this book, according to the preface, is to promote understanding of basic principles of physics and show the connected nature of these principles. It is also intended that the reader will be encouraged to think and draw conclusions rather than merely accept statements. In our opinion, the goal has been achieved. The book is in five parts: Matter, Motion, and Force; Astronomy, A History of Theory; Molecules and Energy; Electricity and Magnetism; Atomic and Nuclear Physics. Part one and Part four are treated thoroughly but in not too unusual a fashion. We were favorably impressed by the simple drawings and the questions. Part two is most interesting and informative. It shows the thinking process of some of our great scientists building upon the work of their predecessors. This is a thoroughly enjoyable history. Part five is modern and complete. This material is a *must* for persons desiring to remain abreast with developments in nuclear science. The reader is able to see the contradictions of existing theories and the theories which evolved in an attempt to overcome the inconsistencies. The insight and boldness of the genius leaves one breathless. A fascinating section on relativity is woven into Part three. Thought-provoking questions and drawings bring out the inconsistencies which led to Einstein's theory, and also give the reader an understanding of the theory. We feel that this book accomplishes its purpose. The non-scientist can learn the basic principles and gain an appreciation of the scientific method. Every science teacher should include this book in his personal library, and the elementary and well-rounded teacher of any subject might well do likewise. In brief, these reviewers found the book to be superior in every respect, and recommend it.

SARA H. CLEMON
D. F. CLEMON, JR.
College Area High School
State College, Pennsylvania

The Two Cultures and the Scientific Revolution. C. P. Snow, 58p. \$1.75. Cambridge University Press, 32 East 57th St., New York 22, N. Y. 1959.

To be asked to review a book by C. P. Snow is exciting, especially when one agrees with most of what Sir Charles says. After reading *The Two Cultures and the Scientific Revolution*, one can only add emphatically, "I wish I had said that."

Actually, the title of the book indicates only half of what Snow has to say. He first points out that there are two cultures in this world ("this world" mainly referring to the United Kingdom and the United States), and that there is almost no communication or conversation between the two: the world of the "haves" and the world of the "have nots." On the one side are the USSR and the Western World, and on the other the vast hordes who are ill-clothed, ill-housed, and ill-fed. In brief, Snow is saying that if our two cultures—the traditional, classic one and the scientific, engineering one—do not get



together and learn to understand each other, they will never be in a position, as the world of the "haves," to help very much in the improvement of the world of the "have nots." But those who live in the world of the "have nots" know that their lot *can* be improved and that it is possible for them to *have*, also. This knowledge creates an imminently dangerous situation. In fact, Sir Charles uses the atom-bomb explosion to illustrate his point. After the first explosion, it was not necessary to show others how to build the bomb, the demonstrated fact that it *would* work makes it possible for others to develop the knowledge without help. In the same way, the "have nots" look at the "haves" today and see that the industrial revolution and the science and engineering on which it is based have given us abundance. Knowing that the system will work, they will insist on having it, too. Whether they develop it within a framework of democracy or of communism is still a moot question; but, if we ignore the problem, we can only delay their progress or toss them into the Russian camp.

There are other areas where Sir Charles strikes even closer to home. He speaks of the high table at Cambridge, where the professors of literature and the arts could not speak to the mathematicians. In American universities, the classicists cannot speak to the physicists, and, indeed, the physicists, in many cases, cannot speak to the engineers. It has been my fate for the past thirty years as an engineer to have to listen to the classicists when they point out that engineers are uncouth and "uncultured." And, perhaps as a result of this goading, I have insisted that engineering education include some of the arts and the humanities. But slowly, too, there has been a dawning realization that the people on the other side of the fence knew nothing of what I was doing; and, to call themselves "broadly educated," they ought to know something about science and engineering. But yet, to this time, they have shown precious little inclination to do so. Perhaps under the prodding of the expert from out of town this will be changed.

Sir Charles not only defines the problem for us but also demonstrates, as with the atom bomb, that it can be solved. He him-

self operates easily and with outstanding effectiveness in not two but three worlds—science, literature, and government. In "The Two Worlds," he deals basically with critical sociological forces with the irrefutable logic of the scientist and the felicity of the accomplished writer. He has charted the course and has shown us that it can be traveled. For both, we are all of us deeply indebted. [See Audio-Visuals, page 61.]

ERIC A. WALKER, President
The Pennsylvania State University
University Park, Pennsylvania

Keep Informed on Astronomy and Space Exploration

Sky and
TELESCOPE

The largest astronomical magazine in the world. Profusely illustrated, each month presenting articles by internationally known astronomers, observing and telescope making departments, star and planet charts, and up-to-date news on the fast-moving advances in the exploration of the universe.

Subscription—U. S. and possessions: 1 year, \$5.00; 2 years, \$9.00. Sample copy on request.

OTHER SKY PUBLICATIONS

Norton's STAR ATLAS—Excellent handbook to the heavens. The 16 charts cover the entire sky, showing over 9,000 stars to magnitude 6½, nebulae, and clusters. Descriptive lists of 500 interesting objects for viewing with small telescopes, and useful data for observing the moon, sun, and planets. \$5.25

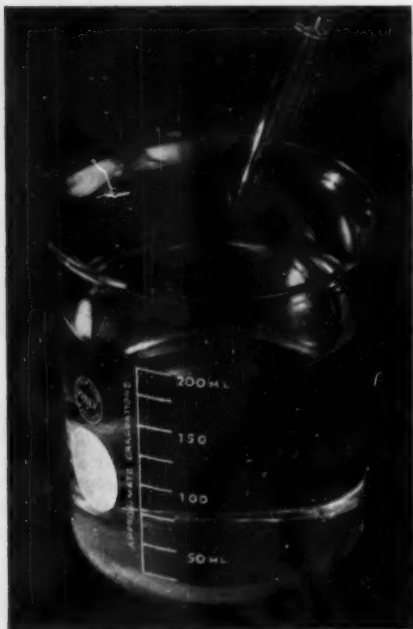
SPLENDORS OF THE SKY—36-page large picture booklet, with short and easy-to-understand captions, designed for the beginner. 50¢

Also available: Picture sets of the moon and celestial objects, star atlases, maps of the moon. Write for free descriptive folder A.

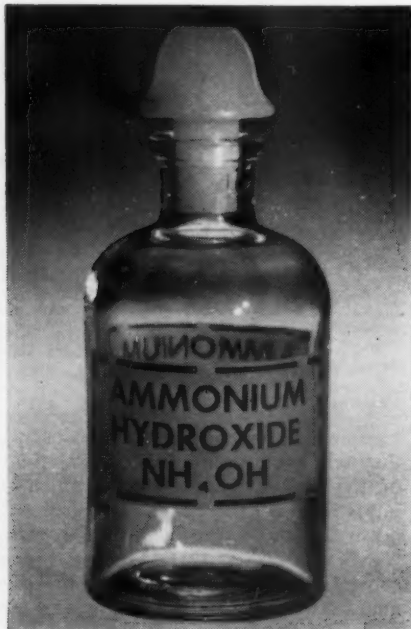
Send check or money order.

SKY PUBLISHING CORPORATION
49A Bay State Road, Cambridge 38, Mass.

Why PYREX® labware is a good b



Machine-made beakers. Each one with walls as heavy and uniform as every other—for maximum strength. For a few pennies more than the cost of the standard No. 1000 beaker, you can get the new No. 1002 with white enamel approximate graduations.



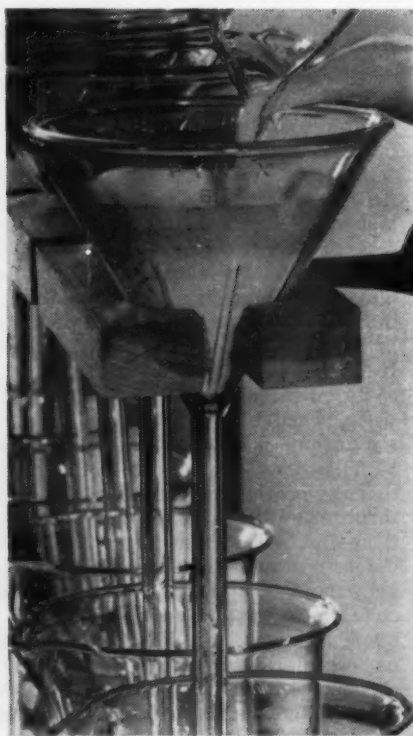
Our No. 1552 reagent bottles make good reading. They're smartly labeled front and back in permanent green on a white enamel background. Ideal for divided-bench use. The bottles won't cloud, the polyethylene stoppers won't stick.



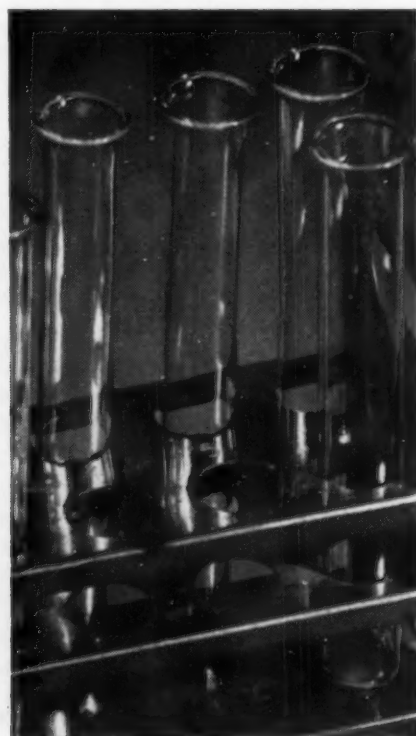
The No. 3075 cylinder is designed for students. Its detachable hexagonal plastic base won't break, discourages the cylinder from tipping and rolling. Cylinder top and spout are heavily reinforced. Sharp, white graduations.



Flasks must take knocks and bangs, quick heating and quick cooling. PYREX boiling, distilling, and Erlenmeyer flasks provide over-all strength for safety. They're designed to conduct heat quickly and evenly.

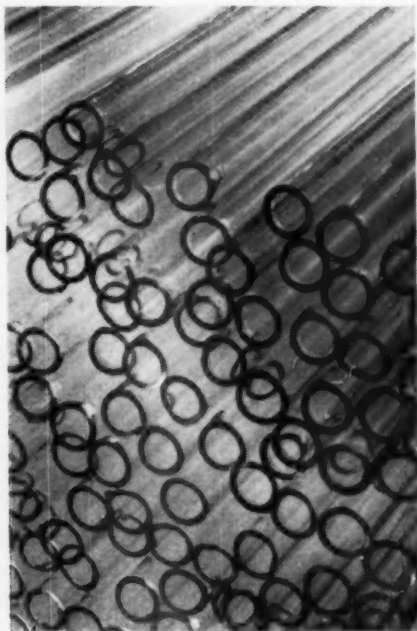


Your students get faster, more complete filtration with Nos. 6160, 6180 funnels, because of filtering grooves pressed into the cone wall. Pressed construction also builds strength and makes for an accurate angle for the filter paper.



Machines make our test tubes stronger, especially at top and bottom hazard points. The tubes are reinforced with a bead at the lip to resist chipping. Bottom radii are machine-uniform in strength, dependability, thermal safety.

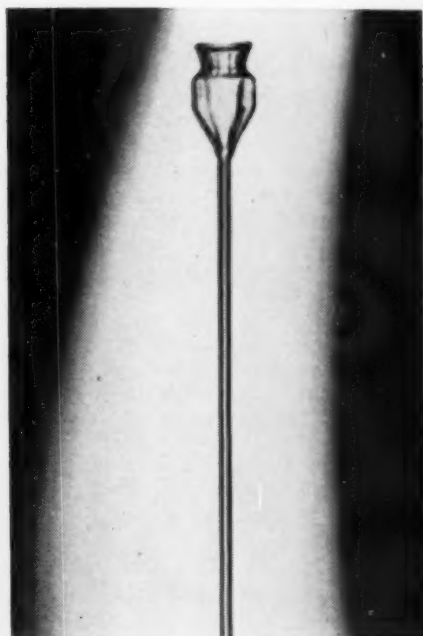
and buy...the old-fashioned kind



Our No. 0088 soft glass tubing and rod work easily for your students over a Bunsen burner, and give them improved chemical durability, too. For heat-resistant applications, we recommend PYREX tubing and rod.



You get Class A accuracy at a real saving in the No. 5650 volumetric flask. You also get the convenience of a screw cap. The plastic cap won't leak or freeze on. There's no stopper to fall out and break. Priced lower than glass-stoppered flasks.



New thistle tube design prevents rolling-off accidents. The square molded design of the No. 6440 gives added strength. Extra glass at the tube-body seal means longer life.



Our molded No. 9985 watch glasses are heavier, stronger than blown types. Their rounded, heat-formed edges increase their strength. Uniform curvature makes stacking easy. You can use them as evaporating dishes, too—they take direct heat.

SCIENCE teachers across the land should always look for bargains in scientific apparatus. But we ask you to keep in mind just what a bargain is.

A graduated cylinder that breaks is no bargain no matter what its price.

A reagent bottle whose markings become illegible is no bargain.

A bargain is when you get *more* than you expected for your money. If you haven't been using the PYREX labware shown here, then we can show you bargains . . . ten of them.


Our bargains show up as such when you take inventory at the end of the semester. That's when you find that our ware tends to last longer than others'. That's when your replacement costs are reduced.

Our bargains show up every time a student uses our ware. He finds out we've allowed for his inexperience. He finds out we make thicker, safer, longer-lasting ware.

Our bargains show up when you find that you can fill all your lab glassware needs with one order and take advantage of quantity discounts.

Check with your lab supply dealer the next time you go bargain hunting.

We have put together a compact new guide to PYREX labware for schools, which is yours for the asking via the coupon.



CORNING MEANS RESEARCH IN GLASS
CORNING GLASS WORKS
 7705 Crystal Street, Corning, New York

Please send me the new "Science Teacher's Guide to Laboratory Glassware."

_____ (name)

_____ (school)

_____ (address)

_____ (city)

_____ (zone) _____ (state)

PYREX® laboratory ware ... the tested tool of modern research



SCIENCE TEACHING MATERIALS

Prepared by NSTA Teaching Materials Review Committee

Chairman: Dr. H. Seymour Fowler

The Pennsylvania State University, University Park, Pennsylvania

BOOK BRIEFS

Science Today for the Elementary School Teacher. John G. Navarra and Joseph Zaffaroni, 470p. \$6.40. Row Peterson Company, Inc., 1911 Ridge Ave., Evanston, Ill., 1960.

Simply written text for the elementary school teacher. Contains appropriate content and a good amount of methodology. Covers most of the areas typical of elementary school science including air, weather, and aviation; space, time, and the earth; matter, energy, and life. Pattern and content not unlike other elementary science methods textbooks.

Satellites in Outer Space. Isaac Asimov. 80p. \$1.95. Random House, Inc., 457 Madison Ave., New York 22, N. Y.

A volume in the new Easy-to-Read Science Books. Summary of important chapter headings follow: Satellites of Earth, Measuring Shape of Earth, Air at Edge of Space, Counting Meteors, Belts of Particles around Earth, Magnets and Paddle Wheels, Pictures of Outer Space, Messages from Satellites, Man into Space. Simplified subject matter in natural sequence; clearly names and explains functions, weights, and orbits of satellites; as well as the significance of data obtained. Introduces new terminology in easily understood manner. John Polgreen's clear, exact illustrations aid comprehension. A volume to capture and hold interest of science classes in grades 3-6.

Biology, A Basic Science. Elwood D. Heiss and Richard H. Lape. 690p. \$5.56. D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, N. J. 1960.

A variation of the scientific method in a basic text. Technical jargon held to a minimum and italicized. Glossary utilizes phonics for ease in pronunciation. Thirty-one chapters of twelve units cover animal behavior, man fights disease, reproduction, heredity, changes through the ages, interrelationships, conservation, and present biological problems. Each chapter presents two or three "problems." "Facts" are gathered in the chapter. Presents "reviews," and itemizes facts

to be utilized in solving original problems. "Solution" tested by presenting a similar problem. Not a colorful book but basic material presented in factual manner.

Edison Experiments You Can Do. Prepared under the direction of International Edison Birthday Celebration Committee of the Thomas Alva Edison Foundation. 130p. Cloth \$2.50. Harper and Brothers, 49 East 33rd St., New York 16, N. Y.

A book based on the original notebooks of Edison. An informative account is given of Edison's life from boyhood to death and the manner in which he worked. Contents include descriptive accounts and how to duplicate the following experiments: The Carbon Button, Speaking Telegraph, Insulation, Electric Light, Fuse, Wireless, Radio Tube, Electric Pen, Phonograph, and The Quadruplex. An excellent reference book for setting up experiments and demonstrations in science classes for junior high school students.

Mollusks, An Introduction to their Form and Functions. J. E. Morton, 232p. \$1.40. Harper and Brothers, 49 East 33rd St., New York 16, N. Y. 1960.

A thorough and interesting coverage of the biology of the mollusks; this readable book fills a gap in the available reference books of Invertebrate Zoology at a reasonable cost. Taxonomy and general anatomy of mollusks are discussed, but the emphasis is on evolution and adaption of structures for the functions they perform (functional morphology). Recommended as an excellent reference book for college classes in zoology and for superior high school biology students.

Project Mercury. Charles Coombs, 64p. \$2.75. William Morrow and Company, 425 Fourth Ave., New York 16, N. Y. 1960.

Presents the problems involved in placing a man in space and returning him to earth, as well as how this can be accomplished. Also described are the construction details of the various stages and about the capsule and fuels used for propulsion. Details of control in flight and transmission of information are discussed. Describes retrieving capsule from ocean after slowing by parachute. A good

library book for elementary classroom to provide information about space flight.

All About the Planets. Patricia Lauber. 140p. \$1.95. Random House, 457 Madison Ave., New York 22, N. Y. 1960.

A volume in the "All About" series. Covers classical theories on formation of the solar system in attractive style and with smooth and logical argument. Describes the tools and methods of the astronomer. Discusses the known planets with special emphasis on the unique characteristics of the earth. Probability of life on other planets is treated with caution. Answers questions most frequently asked by alert junior high school students. Recommended as a guidebook and as junior high level supplementary reading.

State Curriculum Guides in Science, Mathematics, and Modern Foreign Languages, A Bibliography. E. Anne Putnam and Ralph P. Frazier. 28p. 25¢. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C. 1960.

Lists curriculum guides in subject-matter areas mentioned in title from each of the fifty states. Useful to the science educator and to the science teacher working on curriculum. Many of the titles are annotated. Complete, current listing.

Junior Science Book of Flying. Rocco V. Feravolo. 64p. \$2.25. The Garrard Press, Champaign, Ill. 1960.

A thorough treatment of the principles of flight and control of aircraft for the young reader. Suggestions for numerous activities demonstrating lift, drag, thrust, and jet propulsion are clarified through pictures and diagrams.

Junior Science Book of Stars. Phoebe Crosby. 64p. \$2.25. The Garrard Press, Champaign, Ill. 1960.

An attractively illustrated and interestingly written book for the young astronomer. Presents accurate information on the earth, moon, sun, and stars for primary grade children. Introduces new vocabulary and encourages direct observation of astronomical phenomena.

Junior Science Book of Electricity. Rocco V. Feravolo. 60p. \$2.25. The Garrard Press, Champaign, Ill. 1960.

A fairly comprehensive treatment of static and current electricity for the upper primary and early intermediate grades. The numerous suggestions for activities and illustrations stimulate investigation. Topics covered include fuses, dry cells, short circuits, and electromagnets, among others.

The Tale of a Pond. Henry B. Kane. 114p. \$3. Alfred A. Knopf, Inc., New York 22, N. Y. 1960.

This is a nature study book in which the life of a pond through a full year's cycle is vividly re-enacted. The story of the plants, animals, birds, and insects in and about the pond is told in a very picturesque manner through the watchful eyes of a little boy. Chapter headings include: Break of Day, Around the Sun, Family Story, Tall from the Mud, Dragon of the Pond, Net Returns,

Unlikely Trappers, Scales and Armor, Strange Doings, Stalkers on Stilts, and Voice of the Night. Excellent descriptions of biological concepts. The drawings and photographs are comparable to the excellence of the text. Book provides a fine reference for the sixth grade through junior high school.

Junior Science Book of Trees. Robert S. Lemmon. 62p. \$2.25. The Garrard Press, Champaign, Ill. 1960.

An attractively illustrated and simply written story of trees for beginning readers. Functions of roots, stem, and leaves are discussed in relation to tree growth, and types and dissemination of seeds are briefly covered. Includes an introduction to tree identification, forest utilization, conservation, and ecology.

Junior Science Books of Beavers. Alexander L. Crosby. 64p. \$2.25. The Garrard Press, Champaign, Ill. 1960.

The story of beavers and how they live written in an authoritative and simple fashion for younger readers. Contains attractive illustrations of beavers at work building lodges and dams and maps of beaver colonies. Some problems, history, and ecology are also discussed.

Sir Isaac Newton. W. Robert Houston and M. Vere Devault. 48p. \$1.75. Steck Company, Box 16, Austin 61, Texas. 1960.

A picture biography of Sir Isaac Newton. Includes a simple concise explanation of his major contributions to science: Theory of Gravitation, Characteristics of Light and Color, and Laws of Motion. The application of laws to present scientific technology is also included. Contains a selection of simple experiments which would enhance student's understanding of principles presented. Worthy addition to the elementary school science library.

Growing Up with Science. First Edition. Marianne Besser. 218p. \$4.50. McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N. Y. 1960.

Some new ideas in science motivation for everyone. The role of the parent-child team in scientific investigation is emphasized. Discusses how to guide your child in an era of scientific advancement. Includes ideas on answering children's questions about science, and resources for parents in guiding children's interests. Stresses the value of developing an early scientific vocabulary, mathematics, foreign languages, and books. Includes many interesting ideas and sources of additional materials for use in motivating scientific awareness.

Accelerators—Machines of Nuclear Physics. Robert R. Wilson and Raphael Littauer. 196p. 95¢. Published by Anchor Book, Doubleday and Company, Inc., Garden City, N. Y. Available to secondary school students and teachers through Wesleyan University Press, Inc., Columbus 16, Ohio. 1960.

Traces the historical development of high energy particle accelerators and describes the role of scientists who developed these machines. One can read with understanding

the function of accelerators, such as the linear type, and the cyclotron, betatron, synchrotron, and the more modern accelerators. Some pages are devoted to natural products of cosmic accelerators known as cosmic rays. An excellent supplement for enriching high school physics.

Adventures in Algebra. Norman Crowder and Grace Martin. 350p. \$3.95. Doubleday and Company, Inc., Garden City, N. Y. 1960.

A textbook addressed primarily to adult readers who have studied elementary algebra, but who perhaps have not understood it sufficiently. A variety of topics is considered, each intended to bring new insight for the reader. "Is there a largest prime?"—is one topic where the authors show the power of careful reasoning in an algebraic setting. Excellent reading for all prospective mathematics and science teachers.

Wheels. Alice Fleming. 176p. \$3.75. J. B. Lippincott Company, East Washington Square, Philadelphia 5, Pa.

Many facts included. However, these are overshadowed by the theme's clarity in depicting the historical evolution of wheeled vehicles. Chapter titles indicate coverage: The Earliest Vehicles, The Widening World of Wheels, The Heyday of the Carriage, The Two-Wheeler, Trains, Urban Transportation, The Automobile, and Variety on Wheels. Title is misleading since little is said of wheels and nothing of their uses, other than transportation. Many fine illustrations. Excellent for general or supplementary social applications in junior high school science.

Paper. Jerome S. Meyer. 92p. \$3. The World Publishing Company, 2231 West 110th St., Cleveland 2, Ohio. 1960.

A short but comprehensive treatment of paper and its importance to modern civilization. Well written and illustrated with photographs. Describes the many uses of paper and traces its history and manufacture. Explains the chemical and groundwood processes of paper manufacture and the production of paperboard for boxes and cartons. For readers of ten to twelve years.

Flight Facts for Private Pilots. Merrill E. Towers. 212p. Hardbound \$5, Paperbound \$3.50. Aero Publishers, Inc., 2162 Sunset Blvd., Los Angeles 26, Calif. 1960. An excellent and interesting book explaining the "fundamentals of flying." Written especially for the student and private pilot. Sections on theory of flight, the airplane, navigation, weather, and instrument flying are included. The book is generously supplied with photographs and drawings, and contains a glossary of aeronautical terms. Material for this book was contributed by well-known aviation organizations.

First Men To The Moon. Wernher Von Braun. 96p. \$3.95. Holt, Rinehart and Winston, 383 Madison Ave., New York 17, N. Y. 1960.

A completely fascinating story of the first trip to the moon written by the man who knows best what will take place. An exciting narrative from the time the two astronauts

toward
successful
teaching

Practical "handbooks" written by seasoned teachers and supervisors for new teachers and for classroom adoption in teacher training colleges and universities.

"Successful Science Teaching"

by Milton Lesser, Science Dept. Chairman

Written by an experienced science supervisor, this book, guides the beginner through the paths of successful lesson planning in secondary schools.

"Science Experiences for New Elementary School Teachers"

by Donald Salem, Elementary School Sci. Instr.

A classroom teacher's advice on how to make science teaching meaningful to elementary school students.

"Discipline — How to Establish & Maintain It"

by Robert L. Schain

"Practical Classroom Testing" — Formulation, Administration, Evaluation, Follow-up.

by Lillian C. Howitt, Ass't. Principal

\$1.75 per copy. Enclose check or money order. Educational discount — 20% on 20 or more copies. Institutions billed.



TEACHERS PRACTICAL PRESS, INC.
Dept. S

47 Frank Street • Valley Stream, L. I., N. Y.

enter the space capsule on earth until they return; with an interval of several days spent in collecting designated scientific data on the moon. It does not read as fiction, but it makes you live a scientific trip. In the margins Dr. Von Braun clears up many definitions new to the laymen. Recommended for fifteen-year-olds or adults.

The Future of Man. P. B. Medawar. 128p. \$3. Basic Books Inc., 59 Fourth Ave., New York 3, N. Y. 1960.

Chapter headings, include: The Fallibility of Prediction; The Meaning of Fitness; and The Future of Man. The book was written to answer two questions, namely; (1). Is there any real reason to suppose that advances in medicine and hygiene are undermining the fitness of the human race? (2). Is man potentially capable of further evolution, or must we suppose that his evolution has now come to an end? The concepts of genetics and evolution are given somewhat clearly, however, a small knowledge of genetics is helpful in following the author's suppositions and conclusions. A highly interesting book from a biological standpoint and should be an excellent addition to the teacher's reference shelf. For use in advanced biology classes.

There Stand the Giants: The Story of the Redwood Trees. Harriett E. Weaver. 70p. \$2.95. Lane Book Company, Menlo Park, Calif. 1960.

A Sunset Junior Book. Contents include age, discovery, size, the two types of redwoods (Coast and Sierra), lumbering history, uses,

and conservation of redwoods. Beautiful photographs (from fossil to forest). Maps and simple diagrams give biological information about trees in general. Size of trees and cones are compared with objects familiar to children. Growth of tree paralleled with major historical periods. Conservation of trees emphasized. Ends with descriptions of parks. The book is complete, simple, and well balanced. Recommended supplementary reading for beginning biology.

The Trachtenberg Speed System of Basic Mathematics. Translated and Adapted by Ann Cutler and Rudolph McShane. 270p. \$4.95. Doubleday and Company, Inc., 575

Madison Ave., New York 22, N.Y. 1960. The translators have made available to the American public, and especially to teachers of mathematics, the work of a genius who "developed" certain short cuts to mental arithmetic computations. Jakow Trachtenberg, while imprisoned in a German concentration camp, kept himself alive and sane by letting his mind play with the number system which he used as an engineer and applied mathematician. The results were an "organized" set of rules which one can memorize and use to do rapid mental calculations in fundamental operations. Although "there are no multiplication tables" as such, we find that all of the operations require the user to

know what the multiplication tables are. Certainly to "understand" the rules, one must eventually have more "sophistication" than the jacket publicity claims. The translation is accurate, but the claims concerning prerequisites for using the system might be over-enthusiastic. The volume will be a valuable one for enrichment ideas of a knowledgeable teacher of arithmetic and mathematics.

Introduction to Space Age Astronomy. John M. Cavanaugh. 170p. \$2.75. Educational Services, 1730 Eye St., N.W., Washington 6, D.C. 1961.

A detailed, descriptive, non-mathematical treatment of astronomy, designed for a text and workbook in the secondary schools, as well as a supplementary aid in college introductory astronomy courses. The main topics include chapters on The Earth, The Moon, The Sun, The Sun's Family, Time and the Calendar, Eclipses, and The Universe. Throughout the book descriptions of specific topics are kept brief. A discussion of each of the planets is given and included is a table of such data as size, mass, density, period of rotation, gravity, and escape velocity. Fully illustrated with clear line drawings.

The second section is a workbook which specifically follows the chapters of the text. The exercises consist of a series of "fill-in-the-blanks" questions. A crossword-puzzle technique is used in the latter exercises.

"What Is" Series.

Benefic Press, Publishing Division of Berkley-Cardy Company, 1900 North Narragansett, Chicago 39, Ill. 1960.

A 25-per cent discount to schools and libraries; transportation and insurance charges added when 5 or more titles are ordered. Each book 48 pages. List price, \$1.60, Net price \$1.20.

What Is a Cow? Gene Darby.

Good discussion of an animal no longer familiar to boys and girls as a result of urbanization. Should be useful with very small children. Discusses production of milk and its distribution without discussion of pasteurization.

What Is Light? Theodore W. Munch.

Covers light as a form of energy and sources of light. Discusses transmission, reflection, refraction, and absorption. Discusses vision, nature of color, and the conversion of light energy to other forms of energy. Good one-page dictionary of terms included.

What Is a Frog? Gene Darby.

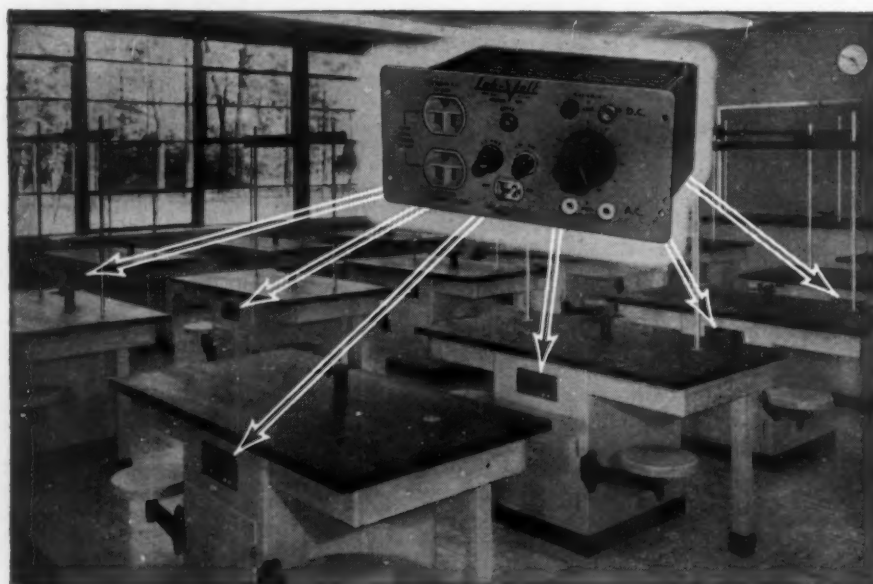
Describes frogs from egg through adult. May be simplified at the expense of factual accuracy. Example: text states that frog cannot stay under water long, but describes hibernation of frog in mud. Somewhat anthropomorphic.

What Is a Tree? Gene Darby.

Discusses parts, structure, and function of trees. Shows a variety of forest products. Some illustrations and ideas are misleading.

What Is a Fish? Gene Darby.

Describes characteristics of form, structure, and function of fish. Some portions may be over-simplified. Gives child an introduction to oddities in the class.



ENRICH YOUR SCIENCE PROGRAM WITH *Lab-Volt*® POWER STATIONS

- EACH INDEPENDENT UNIT PROVIDES COMPLETE, SELF-CONTAINED, VARIABLE A.C. AND D.C. ELECTRICAL SERVICE FOR TWO STUDENTS.
- Students safely do everything themselves, freeing teachers to work with individuals.
- Lab-Volt Power Stations are educationally correct and are now widely used in every state in the union.
- All models are U.L. APPROVED.
- All models simply plug into standard A.C. outlets.
- Models are available for recessed (illustrated) and furniture-top installation as well as for portable service.
- A complete series of detailed and illustrated experiments in electricity and magnetism is furnished to all Lab-Volt users.

SEND TODAY FOR A FREE SAMPLE EXPERIMENT, AND LITERATURE SHOWING HOW THE LAB-VOLT STATION CONCEPT CAN ENRICH YOUR SCIENCE PROGRAM.

Lab-Volt® SCIENCE EQUIPMENT
Division of
BUCK ENGINEERING COMPANY, INC.
36 Marcy St. • Freehold, N. J. • HOPlkins 2-1111



What Is an Atom? Gabriel Reuben and Joseph DiStefano.

An elementary approach to types of atoms telling their size and make-up, how they are studied, atomic radiation, fission and fusion, and nuclear power. Colorful pictures. Picture dictionary. For intermediate grades.

What Is Air? Albert Piltz.

Observations to show we live in an ocean of air which is real, exerts pressure, is necessary to life, changes the earth's surface and works for man. Appropriately illustrated. Picture dictionary. For upper primary or lower intermediate grades.

What Is Gravity? Fred M. King.

Tells how gravity causes weight, falling, earth changes. Timely discussion of importance of gravity to solar system, satellites, and space travel. Explanatory illustrations. Picture dictionary. Intermediate level.

What Is a Magnet? Gabriel Reuben and Gloria Archer.

Observations of magnetic effects, types of magnets, uses of magnets, and cause of magnetism. Illustrations to clarify discussions. Picture dictionary. Intermediate level.

What Is a Season? Gene Darby.

Describes many changes as each season progresses and how the seasons make up a year. Illustrated to follow chosen subjects through four seasons. Primary level.

What Is a Plant? Gene Darby.

Observes plants from a child's viewpoint, what they are, how they grow, how they change, kinds of plants, and their uses. Ample illustrations. Primary grades.

What Is a Solar System? Theodore W. Munch.

A book giving detailed information on: size and make-up of our solar system; its planets, moons, meteors, and their behavior; and the universe.

What Is Electricity? B. John Syrocki.

An explanation of static and current electricity, giving details of: its production, physical make-up and behavior, usage, dangers, as well as information on batteries, switches, fuses, and insulators.

What Is Sound? Gabriel A. Reuben.

An explanation of sound; its origin, behavior under different conditions, its means of travel, its usefulness to man, its qualities, and a brief explanation of sound in relation to man's voice and ear.

What Is a Rocket? Theodore W. Munch.

Covers description, driving force, types of fuel, guiding systems, uses, and rockets in space. An excellent book for the elementary science library.

What Is a Bird? Gene Darby.

This book gives an elementary description of the life cycle of birds. It would be a valuable addition to the elementary science classroom.

What Is a Rock? B. John Syrocki.

This book covers the origin, economic importance, and degradation of igneous, sedimentary, and metamorphic rocks. It would be a worthy item for the elementary library.

What Is a Machine? B. John Syrocki.

A very readable and informative book on the six simple machines. It could be re-read

several times by the interested intermediate grade student. Interesting one-page picture dictionary of machines included.

What Is Chemistry? Daniel Q. Posin.

The material is written at a high level for elementary children using such terms as the periodic table of the elements, neutron, electron, proton, and nucleus. Electron exchange is mentioned. Teacher must be well-versed in chemistry. Appropriate for science oriented pupil of upper elementary grades.

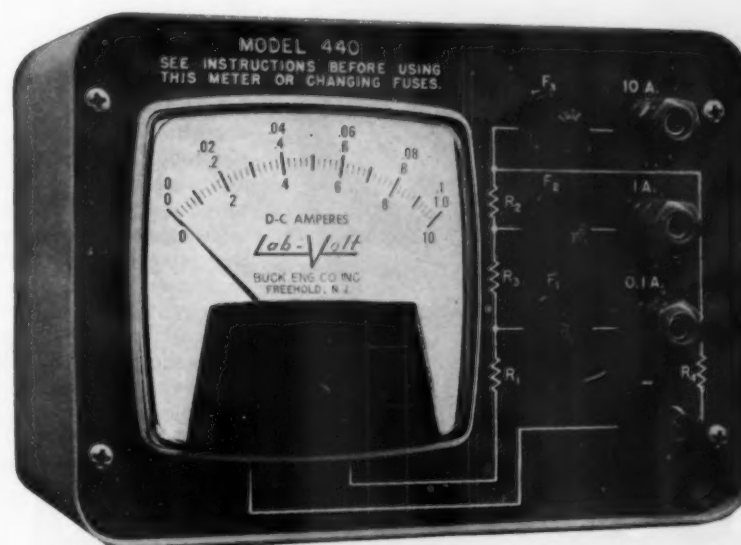
What Is a Star? Daniel Q. Posin.

A fascinating book on stars for the elementary grades. A wide range of topics is introduced along with a few facts pertaining to

each topic. Topics such as what is a star, where did it come from, how we know they are there, are discussed and expertly illustrated. The science-interested fourth grader could profit from this book.

Tony's Birds. Millicent E. Selsam. 64p. \$1.95. Harper and Brothers, 49 East 33rd St., New York 16, N.Y. 1961.

A primary level story of a young boy who learns to know birds through his father's help. The book emphasizes the observation, discovery, and reasoning approach to learning. It also guides the young reader in the proper use of a bird identification book. Useful to adults as well.



NOW **Lab-Volt** BRINGS YOU...

FUSED METERS SAFE FOR STUDENT USE!

Here's a Buck Engineering break-through that will end continuous drain on your science funds for repair or replacement of burned out electrical meters.

This revolutionary feature incorporated in a brand new line of meters (designed expressly for educational work) makes the Lab-Volt Companion Line a must for every science program.

COMPLETE PROTECTION from electrical damage by replaceable fuses. Students may use these units without supervision, as they can't be burned out, even when misused.

FUNCTIONAL Selection of ranges insures easy reading of all values throughout the entire range of every meter. Border-to-border scales are up to 28% larger than older models and are not obscured by pointer or shadows. Units may be used horizontally or vertically and stack compactly for storage. All connections are made through five-way binding posts. A schematic diagram on front panel adds educational value.

DURABLE Sealed mechanisms provide complete protection against moisture and dirt, insuring continuous accuracy of $\pm 2\%$.

Jeweled moving parts insure long life with free movement. Construction is of heavy gage, cold rolled steel, finished in scuff-proof vinyl.

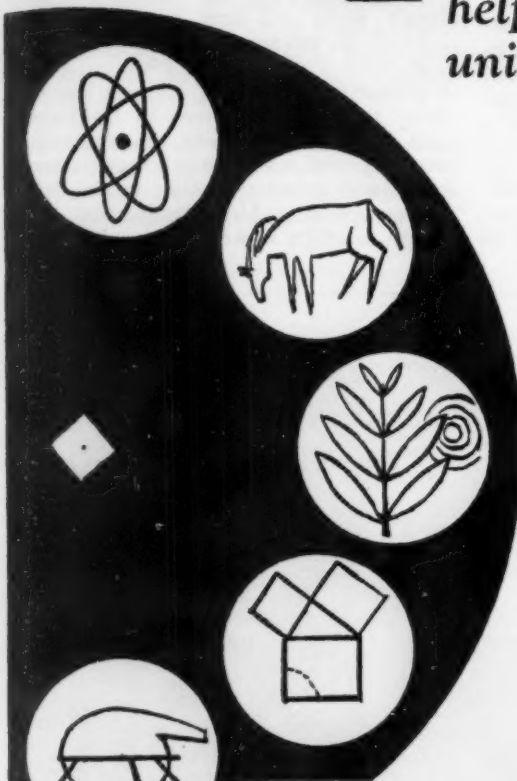
ECONOMICAL Complete metering service is provided by only five competitively priced, multi-range models (A.C. and D.C. voltmeters and ammeters, and D.C. galvanometer).

SEND OR PHONE TODAY FOR COMPLETE INFORMATION

Lab-Volt SCIENCE EQUIPMENT
Division of
BUCK ENGINEERING COMPANY, INC.
36 Marcy St. • Freehold, N. J. • HOPlkins 2-1111

CORONET SCIENCE FILMS

help clarify basic concepts in all important units of instruction



More than 350 vivid, authentic 16mm sound motion pictures help teach all aspects of science. Produced by Coronet Films under the guidance of leading specialists, these excellent films are completely related to the curriculum and are specifically designed to visualize areas which pose special problems for teachers.

Coronet science films are constructive teaching aids, not substitutes for good teaching. They permit competent teachers to extend learning opportunities by bringing to the classroom a variety of stimulating experiences and observations that cannot be presented any other way.

To help science teachers plan their requirements, Coronet Films has prepared master correlation programs in Biology, Chemistry, and Science for the Intermediate Grades. These programs show specifically how Coronet films relate to the major textbooks by indicating for each chapter the films which best clarify the material

A catalogue describing all Coronet films for science in grades 1-12 is also available. Simply use the coupon to receive these useful, free materials.

CORONET FILMS

Dept. SCT-561
Coronet Building, Chicago 1, Illinois

Please send the following materials without charge to help me select and use Coronet science films:

- ☐ Chemistry Correlation Chart
☐ Biology Correlation Chart
☐ Chart Correlating Science films for Intermediate Grades
☐ New Science Catalogue describing 353 films
☐ Specific Film-Text Correlations (Teachers: Furnish names of texts you are using. Correlation of related films will be sent.)

Name _____

School _____

Address _____

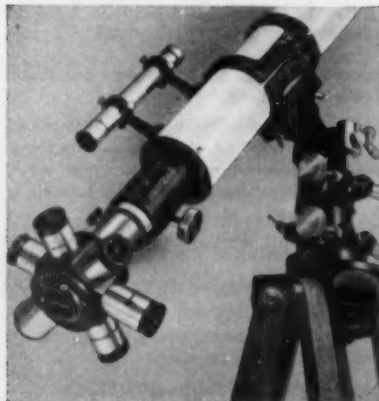
City _____ Zone _____ State _____

THE SKY IS THE LIMIT

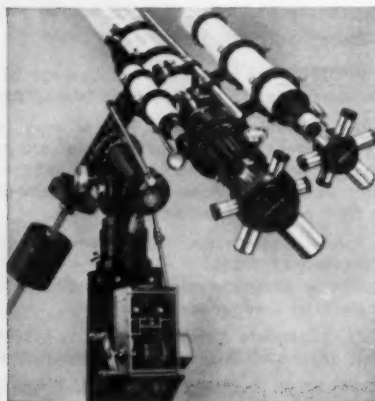
The fiction of Jules Verne is rapidly becoming fact as the world begins to adapt to a new "space-age". Satellites are now in orbit. Sending a rocket to the moon is under active discussion. Outer space travel is sufficiently close for the conducting of military experiments to simulate its conditions.

In teaching, there is a compelling need to give students an opportunity to do more than just read about the universe.

An astronomical telescope must be capable of resolving pinpoints of light at enormous distances. It, therefore, has to be designed specifically with that objective in view. Highly precise and matched optics are essential to obtain the crystal-clear image definition so necessary for astronomical observations to be meaningful. Mechanical mountings must also be built to close tolerances in order to accurately track a star or planet. You will find all of these requirements superbly matched in a UNITRON.



2.4-Inch ALTAZIMUTH REFRACTOR
MODEL 114—COMPLETE with Altazimuth Mounting and slow motion controls for both altitude and azimuth, tripod, 5X-16mm. view finder, rack and pinion focusing, 4 eyepieces (100X, 72X, 50X, 35X), choice of UNIHUX rotary eyepiece selector or star diagonal and erecting prism system, sunglass, dewcap, dustcap, wooden cabinets, instructions..... **\$125.**



4-Inch PHOTO-EQUATORIAL REFRACTOR
MODEL 166—COMPLETE with Equatorial Mounting and slow motion controls for declination and R.A., setting circles with verniers, clock drive, metal pier, Astro-Camera, 10X-42mm. viewfinder, 2.4" guide telescope, rack and pinion focusing, 9 eyepieces (375X-25X). Super-UNIHUX rotary eyepiece selector, sunglass, solar aperture diaphragm, UNIBALANCE, dewcap, dustcap, wooden cabinets, instructions..... **\$1280.**

UNITRON telescopes are America's largest selling refractors. They have withstood the test of time and are fully guaranteed. There are 16 models to choose from and easy payment terms are available.

Here is a selection of UNITRON Refractors:

1.6" Altazimuth	\$ 75.00
2.4" Equatorial	\$ 225.00
3" Altazimuth	\$ 265.00
3" Equatorial	\$ 435.00
4" Altazimuth	\$ 465.00
4" Equatorial	\$ 785.00
6" Photo-Equatorial with clock drive and Astro-Camera	\$5660.00

This valuable 50-page Observers Guide and Catalog is yours for the asking! It will help you in the wise selection of a telescope suitable for your needs and at a price to fit your budget.

Contents include—

- Observing the sun, moon, planets and wonders of the sky
- Constellation map
- Hints for observers
- Glossary of telescope terms
- How to choose a telescope
- Amateur clubs and research programs



UNITRON

INSTRUMENT COMPANY • TELESCOPE SALES DIV.
66 NEEDHAM ST., NEWTON HIGHLANDS 51, MASS.

Please rush to me, free of charge, UNITRON's new Observer's Guide and Telescope Catalog. Dept. 8-P

Name _____

Street _____

City _____ State _____

PROFESSIONAL READING

"The Cromwell Current." By John A. Knauss. *Scientific American*, 204:105. April 1961. A recently discovered current ranks among the greatest of the ocean currents. It flows in an easterly direction along the equator beneath the surface of the Pacific Ocean. Currents in the ocean are due to horizontal pressures of waters of different depths and to the effect of the rotation of the earth. (See April TST, p. 49.)

"Lee Waves in the Atmosphere." By R. S. Scorer. *Scientific American*, 204:124. March 1961. Wind blowing across mountains produce waves in the atmosphere. Characteristic cloud forms indicate the presence of these invisible waves. Cloudscapes are thus an indication of the landscape beneath.

"Atomic Energy Research in the Life and Physical Sciences—1960." U. S. Atomic Energy Commission, Washington, D. C. January 1961. First of a series of yearly special reports of the Atomic Energy Commission devoted to findings and activities in basic research. Specifically includes biological, medical, environmental science, and radiation detection research of the life sciences program and physics and mathematics, chemistry, metallurgy and materials, and controlled thermonuclear research in the physical sciences program. Single copies are available for \$1.25 through the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

"Automation in Education. Machines and Men as Teachers and Learners." Bureau of Publications, Teachers College, Columbia University, 525 West 120th St., New York 27, N. Y. 1960. A reprint of three articles from the December issue of the *Teachers College Record*. Titles include: "Two Models of a Student" by Eugene Galanter, "A Do-It-Yourself Kit for Programmed Instruction" by Ernst Z. Rothkopf, and "The Instructional Gestalt: A Conceptual Framework" by Laurence Siegel. Copies at 50 cents each may be ordered from the Bureau of Publications.

"Yearbook 1961. Balance in the Curriculum." Association for Supervision and Curriculum Development, National Education Association, 1201 Sixteenth St., N. W., Washington 6, D. C. In an effort to represent the objectives of workers in the curriculum field and to determine effective criteria for establishing a balanced curriculum, the ASCD has published a collection of essays written by twelve educators. The Yearbook is not intended to be definitive; rather it is a discussion of the contributors' conceptions of curriculum balance and emphasis. Available for \$4.50 from the ASCD.

"Science in Antarctica." National Academy of Sciences-National Research Council, Washington 25, D. C. 1961. Surveying geophysical, biological, and medical research in Antarctica, this two-part report appraises current scientific knowledge of the area and also considers desirable objectives for future research programs. Part I, The Life Sciences

in Antarctica, deals with Antarctic mammals, fishes, fresh water and marine algae, lichens, birds, bryophytes, marine invertebrate fauna, and other subjects including man in Antarctica. Part II, The Physical Sciences in Antarctica, concentrates on meteorology, oceanography, glaciology, seismology, geodesy, cartography, magnetism, geology, and ionospheric, cosmic ray, auroral, and solar studies. A limited number of copies, \$1.50 for each Part, are available from the National Academy of Sciences, 2101 Constitution Ave., N. W., Washington 25, D. C.

"Guidance for the Academically Talented Student." National Education Association Project on the Academically Talented Student and the American Personnel and Guidance Association. 1961. Report on the conference program of guidance counselors and educators seeking to locate and give opportunity for development to academically talented students in public schools. Emphasis is given to such points as early identification, motivation, and attention to the "creative" student as distinguished from the high achiever. An appendix of student projects and their sources is included. Copies, \$1 each, may be ordered from the NEA, 1201 Sixteenth St., N. W., Washington 6, D. C.

"Human Variability and Learning." Association for Supervision and Curriculum Development, National Education Association, 1201 Sixteenth St., N. W., Washington 6, D. C. 1961. Compilation of reports presented at the fifth curriculum institute on the learning process. Suggests that the creative individual is not readily recognized through the present IQ testing methods. Studies show not only that a distinct difference exists between the "IQ type" and the "creative type," but that "gifted" types are found in other fields, such as planning, evaluation, and communication. Various influences on the learning process for the individual and groups are also discussed. Copies, available for \$1.50 each, may be obtained from the ASCD.

"A Report on the Status of Advanced Biology in Large Secondary Schools of the United States." *The American Biology Teacher*, 23:7. January 1961. The number of advanced biology courses has been increasing steadily since 1952. A majority of these use more than one college text as primary textbooks for the course, supplementing these with other college reference works. Seventy-three per cent of the teachers of these courses have taken college biological science within the past five years. Tables 7 through 15 indicate the degree to which topics of biology are studied in these biology courses.

"Teaching Concepts of Modern Astronomy to Elementary-School Children." *Science Education*, 45:54. February 1961. This study is one phase of an attempt to prepare curriculum materials which are in keeping with current scientific developments. It opens to question the popular theory that content selection should be based on personal and social needs as a result of the finding that children can learn astronomy concepts not related to their lives.

"Selected by SESCO"
is your guarantee
of quality
and effective
science
apparatus



Write
Educational Director
for free folder
of science equipment
information.



Box 451, Vincennes, Ind.

A subsidiary of
Universal Scientific Co., Inc.

RIDER BOOKS

THE MOST EFFECTIVE WAY TO TEACH ELECTRICITY AND ELECTRONICS IN THE PHYSICS CLASSROOM

EFFECTIVE PROVED TEACHING TEXTS

BASIC ELECTRICITY by Van Valkenburgh, Nooger & Neville, Inc. 5-volume civilian version of the U. S. Navy Course with more than 900 illustrations make the fundamentals of electricity crystal clear—DC components and their circuits, AC components and their circuits; AC and DC motors and machinery. #169, 5 vols., soft covers, \$11.25; #169-H, all 5 vols. in one cloth binding, \$12.75.

BASIC ELECTRONICS

by Van Valkenburgh, Nooger & Neville, Inc.
BASIC ELECTRONICS NOW AVAILABLE IN TWO WAYS
BASIC ELECTRONICS, Standard 3-Volume Course. Available as heretofore. 5-volume civilian version of the U. S. Navy Course with more than 800 carefully selected illustrations makes the function and operation of vacuum tube diodes, power supplies, vacuum tube amplifiers, receivers, and transmitters, crystal clear. Only a knowledge of electricity is required for complete understanding of this subject. #170, set of Vols. I to V in soft covers, \$11.25; #170-H, all 5 vols. in single cloth binding, \$12.75.

BASIC ELECTRONICS EXPANDED COURSE. A 6-Volume course consisting of the original five volumes that deal with vacuum tube diodes, power supplies, vacuum tube amplifiers, oscillators, receivers, and transmitters—and a sixth volume that covers semiconductors, transistors, and frequency modulation. Transistors and semiconductors are the most modern devices in electronic technology. Everyone interested in the broad subject of electronics now must have a familiarity with transistors and semiconductors. The fastest and easiest way of getting this knowledge is by studying this 6-volume course. #170-X, set of Vols. I to VI in soft covers, \$13.85; #170-XH, all 6 vols. in a single cloth binding, \$14.85.

BASIC ELECTRONICS VOL. VI ONLY. For the many schools which are now using the 5-volume course and wish to expand instruction into the areas of semiconductors, transistors, and frequency modulation. #170-6, soft, \$2.90; #170-H, cloth, \$3.95.

There are more than 200 Rider titles covering all areas of Electronics and Science. Send for examination copies on 30 day approval. At end of 30 days either remit the price of the book, or return it without cost. School discounts apply.

BASIC TELEVISION by Dr. Alexander Schure. A 5-volume "pictured-text" course. Telephony says, "Undoubtedly the most understandable presentation . . . thorough and accurate." #198, soft cover, 5 vols. per set, #198-H, all 5 vols. in one cloth binding. Write for price of special school edition.

RADIO RECEIVER LABORATORY MANUAL by Alex W. Levey, B.A., M.S. A workbook of experiments, designed for students of radio and radio servicing. #178, \$2.00.

PRACTICAL SHOP MATHEMATICS (5th Ed. Revised) (formerly Arithmetic for Engineers) by Charles B. Clapham. Science and Mathematics magazine says "... clear, concise, easy to follow, and remarkably understandable . . . the whole field of practical mathematics is explained . . ." More than 390 numerical examples of solutions fully explained. More than 1,950 problem exercises, with answers, #183, Cloth Bound, \$6.59.

ADVANCED TV SERVICING TECHNIQUES by Zbar and Schildkraut. A complete advanced TV servicing course, developed by the Electronics Industries Association. Soft cover, 8 1/2 x 11". MAIN TEXT, #161, \$3.60; LABORATORY WORKBOOK, #161-2, \$9.95; INSTRUCTORS GUIDE: Available to schools only, at no charge.

TELEVISION—HOW IT WORKS (2nd Edition) by J. Richard Johnson. It is the newest and most comprehensive text on the subject and follows the progress of the received signal from the antenna to the picture tube and loudspeaker. Each illustration conveys its message in the clearest and most complete manner. The text is equally apt for home study or formal school courses. Electronic & Appliance Specialist. MARCO Cover. #101, \$4.60; #101-H, Cloth, \$5.50.

REPAIRING TELEVISION RECEIVERS by Cyrus Glickstein. The most modern completely practical book, written by an expert with long experience in television receiver repair. Devoted to trouble-shooting and repair techniques which are modern, yet down-to-earth. #191, \$4.40.

EXCELLENT REFERENCE BOOKS—A MUST FOR EVERY HIGH SCHOOL PHYSICS LIBRARY

ENCYCLOPEDIA ON CATHODE-RAY OSCILLOSCOPES & THEIR USES by John F. Rider & Seymour Ulan (2nd Edition, revised and enlarged). Journal of S.M.P.T.E. says, "Well written, lucid, and profusely illustrated with excellent photographs and drawings." 1360 pages, 23 chapters, 3,000 illustrations, #133, \$27.00.

BASICS OF DIGITAL COMPUTERS ("Pictured-Text" Course) by J. S. Murphy. "The simplest and most fascinating method of mastering the fundamentals" says Geniac Associates. #196, 3 vols., soft covers, \$8.40; #196-H, all 3 vols. in one cloth binding, \$9.50.

HOW TO STUDY AND TAKE EXAMS by Lincoln Pettit, Ph.D. "As competition to college takes on an alarming aspect, the book is of prime importance to those who want to get in and stay in college"—M. V. Holman, Ed. D., Dean of Students, Patterson (NJ) State College. #274, \$1.00.

INTRODUCTION TO ATOMIC ENERGY by William G. Atkinson. "Excellent as a supplemental reading assignment for the high school science student"—Henry McClelland, Supervisor of Training, Goodyear Atomic Corp. #271, \$1.35.

RADIO OPERATORS' LICENSE Q & A MANUAL, 6th edition, by Milton Kaufman, #133, cloth, \$7.10.

BASIC TRANSISTORS ("Pictured-Text" Course) by Alex Schure, Ph.D. #262, soft cover, \$3.95; #262-H, cloth, \$5.50.

BASICS OF ANALOG COMPUTERS ("Pictured-Text" Course) by Thos. D. Truitt & A. P. Rogers. #256-H, 3 vols., one cloth binding, \$12.50.

BASICS OF GYROSCOPES ("Pictured-Text" Course) by Carl Machover. #257, 2 vols., soft cover, \$6.60; #257-H, 2 vols. in one cloth binding, \$7.75.

BASIC AUDIO ("Pictured-Text" Course) by Norman H. Crowhurst. #201, 3 vols., soft covers, \$8.70; #201-H, 3 vols., one cloth binding, \$9.95.

EFFECTS OF NUCLEAR RADIATION ON MEN AND MATERIALS by T. C. Helvey, Ph.D. #243, \$1.80.

HOW TO READ SCHEMATIC DIAGRAMS by David Mark. #208, \$3.50.

JOHN F. RIDER PUBLISHER, INC., 116 West 14th Street, New York 11, N. Y.

Ten years from now you'll be glad you bought GRAF-APSCO



THE ORIGINAL "SAFETY FEATURE" MICROSCOPE

\$105.30 EACH

in quantities of 5 or more
\$117.00 EACH LIST PRICE

Graf-Apsco

STUDENT MICROSCOPE

MODEL GB2A (WITH CONCAVE MIRROR)

ALL METAL CONSTRUCTION

INDEPENDENT FINE ADJUSTMENT (NOT ONE THAT ACTS ON THE COARSE ADJUSTMENT)

FIRST QUALITY MEDICAL OPTICS

16mm OBJECTIVE (10X) N.A. 0.27

4mm OBJECTIVE (44X) N.A. 0.66

10X HUYGHENIAN OCULAR

ELONGATED BASE TO PROTECT OBJECTIVES

SAFETY MOUNTING OF MIRROR

DISC DIAPHRAGM LIGHT CONTROL

Lower price \$117.00

In quantities of 5 or more Each 105.30

TRANSPORTATION INCLUDED

Or with substage illuminator instead of mirror.....Same price

THE GRAF-APSCO COMPANY

5868 Broadway

Chicago 40, Ill.



Model GB2A

Approved for purchase under N.D.E.A.

"Independent Activities for Creative Learning." By Helen Fisher Darrow and R. Van Allen. *Practical Suggestions for Teaching*, No. 21, Edited by Alice Miel. 110p. \$1.25. 1961. Bureau of Publications, Teachers College, Columbia University, New York City. This publication is designed to aid the classroom teachers who aim to place a greater emphasis on creative self-expression. Effective ways of organizing the classroom for independent activities and for promoting creative thinking are given. Four main chapters are Action for Independence, Organizing the Daily Program for Independent Activities, Independent Activities which Promote Creative Learning, and Using Skills Through Self-Expression. Contains specific illustrations, tables, and many practical suggestions which are inexpensive as well as readily available in most classrooms. Excellent presentation of teaching techniques.

"Science. Grades 1-9." This is the first of a series of leadership bulletins prepared by the Texas Education Agency designed to assist local schools in the development of curriculum plans recommended under the 1958-59 Texas Curriculum Studies. The guide introduces a list of natural science principles for grades 1-9, in the areas of physical, biological, and earth sciences and shows how they can be incorporated into useful teaching units. Presented in the form of teaching outlines, this material is directed at developing skills which pupils may continue to apply throughout life, and is intended to encourage science teaching at the listed grade levels. February 1961.

For comments or information on the series write to Calvin D. Hibler, Assistant Director, Division of Program Development and School Accreditation, Texas Education Agency, Austin, Texas.

AUDIO-VISUAL AIDS

Science for Science—The Story of the Scientific Laboratory Furniture Industry. A new 35-mm color filmstrip in sound produced by the research and development committee of the laboratory equipment section of the Scientific Apparatus Makers Association. The processes of planning and building school scientific laboratories are shown. From the initial steps in the science-room planning, the viewer is shown the industry's vast engineering, design, and drafting department resources, and demonstrations of actual production operation in the building of laboratory furniture. Interested school executives, school board members, science educators, and citizen groups may write for additional information to: Laboratory Equipment Section, Scientific Apparatus Makers Association, 20 North Wacker Drive, Chicago 6, Ill.

Industrial Applications of Radioisotopes. A semi-technical 16-mm film surveying the current widespread uses of radioisotopes in American industry. The film story demon-

strates examples of industrial uses of isotopes for thickness, density, and level gauging, radiography, and tracing. Specific applications of rubber products, sheet metal, plastics, paper, nylon, food and containers, ship-building, oil, automobiles, and future potential uses of isotopes are shown. Basic principles of radioisotopes are explained through animation. Though of interest to a broad audience, the film is designed to acquaint industrial management with the versatility, the economy and ease with which radioisotope techniques can be adapted to plant requirements. 57 min. Color. Free loan or purchase. 1961. Prints are available for purchase from the Army Pictorial Center, 35-11 35th Ave., Long Island City 1, N. Y. Information on purchase of prints by private or government agencies, including cost, may be obtained from the Audio-Visual Branch, Office of Public Information, U.S. Atomic Energy Commission, Washington 25, D.C.

Science of Light. A film correlated with the Heath Science Series. As an illustration of the concept, a young boy is shown as he asks himself questions about light and then tries to answer the questions. These involve the nature of sight, the speed of light, reflection from a variety of surfaces, and absorption and heating effects. A simple explanation of refraction is included. Differences between bodies which are opaque, transparent, and translucent are demonstrated by the employment of animation, photomicrography, and visualization. Recommended as an introduction to light for science classes in the intermediate grades. 11 min. Color \$110, B&W \$60. 1960. Churchill-Wexler Film Productions, 801 North Seward St., Los Angeles 38, Calif.

Life in the Woodlot.* This is an excellent film on introductory ecology. It weaves in a story of an owner of a woodlot demonstrating his knowledge of changes, both seasonal and long-time, which have occurred in the woodlot. The pyramid of numbers is well portrayed through discussion of relationships such as predation and competition. The pyramid develops with these steps: the plants, insect grubs, young fledgling grouse chick, snake, hawk, and man. Competition among plants for light is illustrated. Long-time conversation practices are illustrated. The film shows the forest as an esthetic resource as well as a commercial resource. For the alert biology teacher, this film would provide an excellent treatment of the ecology of a hardwood woodland. For the unit on conservation, it would serve the purpose of stimulating a real interest in ecological relationships and explain the foundation part they play in good conservation practices. Film is recommended for high school biology and for use in instructing lay groups in many aspects of conservation. 17 min. Prices undetermined but in the following range: Color \$190, B&W \$100. 1960. National Film Board of Canada, 680 Fifth Ave., New York 19, N. Y.

*NOTE: An earlier review of this item (See April TST, page 69) did not carry accurate data, and is, therefore, revised above.

NOTICE TO READERS

NSTA members receiving Packet No. 56 will have by now read about the free materials listed in the March 1961 copy of the NSTA News Bulletin. On page 4 of the News Bulletin, the following item "Closing the Gap" was listed as available from the Scientific Apparatus Makers Association, 20 North Wacker Drive, Chicago 6.

We have been advised that this item is **OUT OF PRINT** and **NO LONGER AVAILABLE**. Since no reprinting has been planned, it is suggested that no requests be forwarded to SAMA for this booklet.

The Two Cultures and the Scientific Revolution. This thirty-minute, long-playing record, representing a review of the book by C. P. Snow, was produced for the Young Book Reviewers' radio program, Station WMCA, New York City. Participating student panelists, a guest, and a moderator chose important points from Sir Charles' volume for discussion and debate. The conflict between scientists and humanists is well presented.

DO LAB EXPERIMENTS IN ANY CLASSROOM WITH Turner Portable Bunsen Burner



Hundreds of schools are now taking science experiments into any classroom with the Turner portable bunsen burner. It's the self-contained heating unit that requires no gas outlet or hose connections.

The Turner Bunsen Burner is UL approved and features a variety of heads for different work. Clean burning propane gas is contained in the safety-tested disposable tank.

Complete with tank of fuel \$10.50, from your lab or school supply distributor.

For information and literature write:

Turner Corporation
823 PARK AVENUE • SYCAMORE, ILLINOIS

The recording serves as a follow-up to the book. In fact, this reviewer questions the advisability of presentation of the record alone without previous reading of the book. Recommended for the more alert senior high school students, grades 11 and 12. 30 min. Price not quoted. 1960. Requests for a copy of the record should be addressed to Cambridge University Press, 32 East 57th St., New York 22, N. Y., Attention: Science Department. (See Review of Snow's book on page 51.)

Mystery of Time. An excellent film which uses the high-speed camera to alter time dimension. The photography is fine, and

the commentary well done. Slow-motion photography is utilized to lengthen time sequence in demonstrating an arrow striking an egg and a drop of milk striking a liquid surface. One feature adds interest by speeding events of a long period of time into a few minutes. Relativity and the interrelationships of time, space, and matter are simply, yet dramatically portrayed, by showing horizontal and vertical contraction. The audio portion is used to good advantage in demonstrating lowering of voice pitch and slower heartbeat at high acceleration in approaching the speed of sound. Recommended for high school physical science classes. It would also serve as an informational film for the general pub-

lic. 40 min. Color \$340. 1960. Moody Institute of Science, 11428 Santa Monica Blvd., Los Angeles 25, Calif.

Weather Scientists. One of the films in the New United World Elementary Science Series. Does an excellent job of showing how the U.S. Weather Bureau functions in predicting weather. Shows how weather data is collected from a variety of sources, including local offices, regional centers, airplanes, and ships at sea. Illustrates how all data collected are processed by electronic computers. Photography of technicians at work plotting weather maps is excellent. Interpretation of maps also well presented. Numerous weather instruments are shown and their operation and function explained. A portion of the film treats weather's influence on our daily lives. Highly recommended for general science grades 6-9. 13½ min. Color \$135. 1960. United World Films, Inc., 1445 Park Ave., New York 29, N. Y.

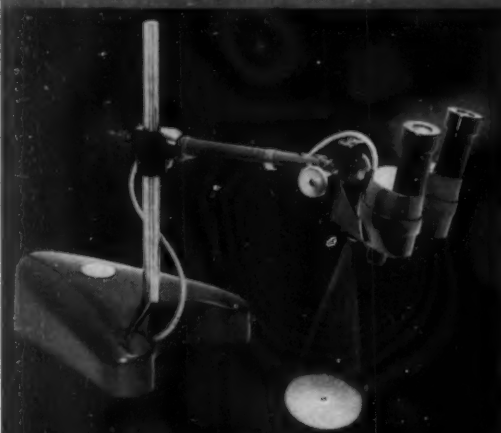
Principles of Chromatography. A film demonstrating the technique of separating materials by chromatography. Four different methods are clearly illustrated and described: separation by absorption, partition, the use of paper, and an interesting two-way method. This British film should be of particular interest to advanced high school chemistry students because the subject is clearly explained and can be easily adapted for projects. 20 min. Color \$190. 1960. Contemporary Films, 267 West 25th St., New York 1, N. Y.

The True Book Filmstrips of Physical Science. A set of six filmstrips illustrating a variety of topics covered in elementary science. Recommended for upper primary and early intermediate grades. Titles: Air Around Us, Deserts, Moon, Sun and Stars, Oceans, Rocks and Minerals, and Seasons. May be used with other series of True Books or as an independent unit of study. Color. Set \$28.50, \$4.75 each. 1960. Childrens Press, 300 South Racine Ave., Chicago 7, Ill.

The True Book Filmstrips of Biological Science. A set of six filmstrips designed for early and middle elementary grades to enhance the study of living things. Titles are: Dinosaurs, Farm Animals, Pets, Reptiles, Tropical Fishes, and Your Body and You. Colorful pictures and drawings are of interest to children, and the captions are suitable for the beginning independent reader. May be used separately or coordinated with other True Books. Color. Set \$28.50, \$4.75 each. 1960. Childrens Press, 300 South Racine Ave., Chicago 7, Ill.

Marshes of the Mississippi. This fine natural history film takes the viewer on a trip through the wastelands of the Mississippi Delta and shows how new land is being formed at the mouth of the river. Excellent wildlife photography. Includes many details about alligators, turtles, mink, otters, raccoons, muskrats, nutria, and other forms. A professional trapper, preparing for the harvest of pelts, is shown. Film points out how the marshes are used as wintering grounds for ducks and geese. The com-

S T E R I M A G



Crystal sharp
stereoscopic image
Built-in focusable light source
Long 7" working distance
— wide field
Stable base with
universally adjustable mounting
Fixed magnification
10X and 20X models

each \$165

COOKE, TROUGHTON & SIMMS
INCORPORATED
51 WAITE STREET, MALDEN 48, MASSACHUSETTS
CANADA: 77 ORENVILLE STREET, TORONTO

CTS

Tel. DA-4-6666

just published:

SCIENCE TEACHING
IN THE
SECONDARY SCHOOL

Nathan S. Washton

Based on extensive educational research, here is a text and reference for prospective and in-service science teachers in junior and senior high schools. Over 250 prominent science educators were consulted in the development of this book. 319 pp. \$5.00

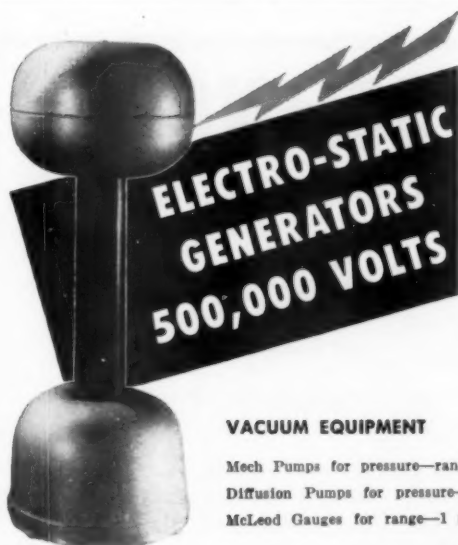
Harper & Brothers, 49 E. 33 St., N.Y. 16, N.Y.

mentary gives a good, objective lesson in conservation. Has general appeal and is also recommended for ecology and conservation units in junior and senior high school science and biology. 12 min. Color \$120, B&W \$60. 1960. Avalon Daggett Productions, 441 North Orange Drive, Los Angeles 36, Calif.

The True Book Filmstrips of Natural Science. Six filmstrips of general interest to children in primary and early intermediate grades. Recommended for independent showing or in conjunction with other True Books. Titles are: Animal Babies, Animals of Sea and Shore, Birds We Know, Insects, Plants

We Know, and Trees. The sequences are good. Suitable for reading at upper grade levels. Color. Set \$28.50, \$4.75 each. 1960. Childrens Press, 300 South Racine Ave., Chicago 7, Ill.

The Face of the High Arctic. An excellent film introducing the viewer to an unfamiliar land. Describes changes in the Arctic from a land of temperate climate to today's barren wastes. Photographs clearly illustrate evidence for these changes, including that in coal strata and imprints of marine creatures. Also shown are evidences of past and present glaciation. This film illustrates the value of a medium in bringing to a viewer an



Stroboscopes, St. Louis Motors, other LOW priced quality science equipment . . . write for FREE catalogs.

VACUUM EQUIPMENT

Mech Pumps for pressure—range—1 Atmosphere down to 150 microns.....\$34.50
Diffusion Pumps for pressure—range—down to .01 microns.....\$18.50
McLeod Gauges for range—1 micron to 1000 microns.....\$14.00

500,000 Volts — Kit or Assembled

36" high, 14" Alum. oblates and frame. Kit includes all necessary parts, experiments, directions, drawings.

\$37.50 Post Paid

Deluxe Model—w. ball bearing motor, assembled, delivers 12 microamp current. Warranted 5 yrs. or 2000 operating hours. F.O.B. Buffalo—\$128.00. OTHER MODELS TO 1,000,000 VOLTS.

200,000 Volts — KITS \$24.50 Post Paid

(can be assembled with pliers and screw driver)
Specifications—17" high, 7" diameter, 200,000 volt potential, 1.5 to 2.5 microamp. 0-90% relative humidity range. Life-of-service . . . over 1000 operating hours. 110v 60 cycle AC motor. Insulating column of unbreakable vinyl chlorides. Oil impregnated bronze bearings. Housing, base, frame, and charge collector are made of aluminum. Wt—5 lbs.

Fully Assembled \$39.50 Post Paid

MORRIS and LEE
DEPT. ST-5
294 ELM ST., Buffalo 3, N. Y.



Stereoscopic and Widefield Microscope

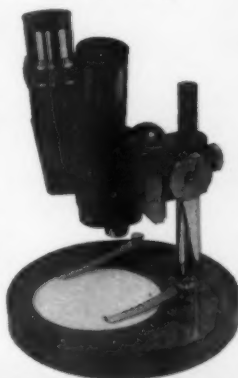
Can Be Your Greatest Classroom Help

Swift Stereoscopic and Widefield Microscope is truly an outstanding instrument for classroom use. Deep, erect, three-dimensional image that is right-side-up gives the added advantage of no inverted image. Long working distance with splendid field of view 10mm at 20 power. Can be elevated to examine large Botanical specimens, or used over a culture dish. The stage is large and very useful. This Swift model is a must for every Science classroom.

Model SBW-1, vertical binocular body with interpupillary adjustment and diopter adjusting scale on right eyepiece tube, to correct for any difference between operator's eyes. Built in 2x objective, Widefield eyepieces 10x, 15x; power range 20x-30x. All optics are Swift Rubycoated to obtain best possible resolution. Stable, well-balanced stand with opaque center plate which is removable; large, durable stage clips. Instrument can be elevated on standard. Modern sand finish. Complete in wooden cabinet with lock and key.

Only **109.80** in lots of 5 or more

12200 each.



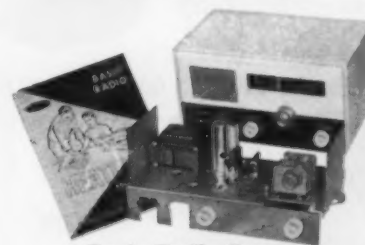
SWIFT INSTRUMENTS, Inc.

1572 N. FOURTH STREET • SAN JOSE, CALIFORNIA

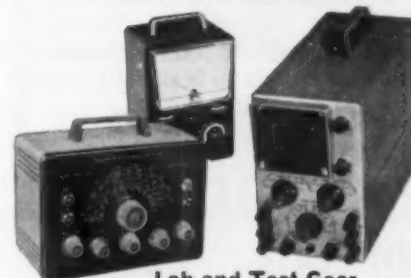
HEATHKIT® CAN MAKE YOUR TEACHING EASIER — BETTER!



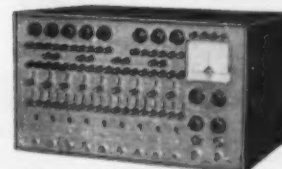
Basic Electricity Course



Basic Radio Course



Lab and Test Gear



Educational Computer

Whether you are setting up a new project program or equipping your labs, Heathkit can fill your every educational electronic need! More than 200 different kits stand ready to make your teaching easier, better and fit your budget. Choose from our Educational kits, Test and Lab equipment, Computers, Hi-Fi tuners, Amplifiers and Recorders, Portables, Intercoms, Citizen's Band Radio, Amateur Radio and Marine equipment. Send for your Free copy of the latest Heathkit catalog today!

HEATHKIT® <small>by Design</small>		
HEATH COMPANY		
Benton Harbor 31, Michigan		
Please send me the Free Heathkit Catalog		
NAME _____		
ADDRESS _____		
CITY _____	ZONE _____	STATE _____
Order by mail or see your Heathkit Dealer		

SEMI-MICRO FOR SCHOOLS

CENTRIFUGE

COMPLETELY SAFE
for student use.

Interchangeable cast aluminum head holds 10 x 75 mm tubes and 13 x 100 mm tubes. No waiting — stop Centrifuge with slight palm pressure. Silent, ruggedly built for long life.

No. T 3080 Waco Separator for 110 volt 60 cycle \$47.00



SPATULAS

Only 24¢ each



HAND FINISHED Spatulas perfectly shaped for semi-micro. Corrosion-resistant monel metal with a red plastic handle. Blade is slightly dished with a round bottom.

No. T 10115—Waco Spatulas, monel, 175 mm long, 23 x 5 mm blade tapered to 3mm tip.

\$3.10 per dozen

\$24.00 per 100

HOT PLATE

A 3" personal hot plate for each student. Priced under three dollars. Made to specifications of Dr. L. F. Fieser for organic semi-micro. Nichrome element and highly conductive aluminum head. Complete with cord set. No. T6612—

Waco hot plate \$2.95



BURNER

Adjustable Natural and Mixed Gases. Both gas and air are adjustable for full control of flame. Nickel-plated brass with flame stabilizer top. Takes 7/16 wing-top, burner height 85 mm.

No. T 2627 Waco Burner \$1.80 ea.

Dozen or more \$1.60 ea.

WRITE FOR FREE SEMI-MICRO
Catalog No. T-4



LABORATORY SUPPLIES AND CHEMICALS
WILKENS-ANDERSON CO.

4525 W. DIVISION ST., CHICAGO 51, ILLINOIS

experience he might not have had. The locale is the Queen Elizabeth Islands in the Canadian Arctic. Recommended for earth science classes in particular. Useful also in geology units in general science, and in geography. Appeal for students from grade six through college. 13 min. Color \$150, B&W \$75. 1960. National Film Board of Canada, 680 Fifth Ave., New York 19, N. Y.

Life in the Ocean. Shown in color are the following plants and animals: diatoms, seaweed, sea anemone, sea fan, sea star, sea urchin, sea cucumber, sea worm, cowrie, sea slug, nudibranch, shore crab, fishes, hornshark, bass, sea horse, turtle, sea lion, and porpoise. The excellent photography

shows the external structures in operation, such as the motion of the tube feet of the starfish, opening and closing of the mouth of the sea urchin, contraction of the sea cucumber when touched, movement of the tentacles and mouth in mollusks, use of pincers by the shore crab, intelligence of the porpoise, etc. Since most of the pictures were taken in an oceanarium, the animals are not in their natural habitat. The film is suitable for upper elementary and junior high school students in nature study or science. The film holds pupil interest well and presents many possibilities for further discussion. Color \$160, B&W \$85. 1960. Film Associates of California, 11014 Santa Monica Blvd., Los Angeles 25, Calif.

The latest in **SCIENCE**

FOR CLASSROOM AND LIBRARY

DINOSAURS

Their Discovery and Their World

DR. EDWIN H. COLBERT

Chairman of the Department of Vertebrate Paleontology,
American Museum of Natural History

By an outstanding authority, this comprehensive book is a definitive work on dinosaurs and their history: where dinosaur fossils have been found and may be seen today; dinosaur habits, tracks, eggs, ecology and distribution. Special features: a classification of dinosaurs, arranged geologically and geographically; list of books; bibliographies of vertebrate paleontology. 342 pages. Over 100 illustrations.

JUNE 26 \$7.50

CAREERS AND OPPORTUNITIES IN PHYSICS

New, revised edition of YOUR CAREER IN PHYSICS

PHILIP POLLACK

Author of CAREERS AND OPPORTUNITIES IN
SCIENCE; A SURVEY OF ALL FIELDS, etc.

An extensively revised, completely up-dated edition of Pollack's book which was one of FOUR listed for reference use in the Atomic Energy Commission's "Memorandum to High School Students on Careers in the Field of Atomic Energy." Career coverage includes electronics, nuclear physics, atmospheric physics, meteorological research, aeronautics and space flight, chemical physics. Current conditions and opportunities are graphically described, qualifications needed, educational requirements, salaries. Illustrated with photographs.

JUNE 16 \$3.75

WRITE FOR LIST OF DUTTON BOOKS SUITABLE
FOR PURCHASE UNDER TITLE III OF THE NDEA

E. P. DUTTON 300 PARK AVE. SOUTH NEW YORK 10

APPARATUS & EQUIPMENT

The Variable Phase Wave Generator Kit, No. 3100. This is a device for producing out-of-phase, point-source ripples in the ripple tank furnished by this Company. The generator consists of a baseboard, to which a small motor with a double-ended shaft is attached, and an eccentric drive apparatus for each of two "pop-pearl" point sources. The drives involve spring clothespins and an arrangement of brass sleeves rotating around a brass-tube shaft. They are independently

adjustable by rotating the wooden cams on the motor shaft, thus providing the phase variation. Minor difficulty may be experienced in assembly because of misplaced holes in one pre-cut wooden part. (The holes were redrilled and the assembly was completed with no further difficulty.) The producers indicate that this is being corrected. The base, about two cm thick, permits the generator to rest on the bottom of the ripple tank with the motor out of the water and the point sources adjusted to contact the water. In this device, as in the ripple tank, wooden parts should be waxed or varnished. Physical Science Study Committee equipment. One unit is recommended for each pair of students. In general, the device is

*Life-Size •
Authentic • Low-Cost*

PLASTIC TEACHING AID

This faithfully reproduced plastic skeleton has true bone color, texture and appearance. Fully articulated, with soft, vinyl plastic intervertebral discs. Muscle origins in red and insertions in blue painted and labeled on one side for easy reference. Invaluable as teaching aid.

Reproduction is complete in every detail, thoroughly checked by major anatomists. Models can be handled freely — unbreakable in normal use. Should any part get broken or lost, repair or replacement is available at low cost. May be marked on with ink or crayon, and easily erased with soap and water. Never become greasy or offensive. Used extensively by leading schools and universities throughout America.


Write for complete catalog of MPL anatomical models, including skulls, skeletons, heart and parts. Priced from \$18 up.

*Request your model
through Title III of National
Defense Education Act*



Life-size model SK-25
muscle skeleton complete **\$295⁰⁰**

**MEDICAL PLASTICS
LABORATORY**
DEPT-ST, GATESVILLE, TEXAS



BESELER VU-GRAPH

*The Right Hand
of Teaching*

Operated from the front of a fully lighted room the Vu Graph is a teacher's "electric black-board." Facing the class at all times, the teacher projects what he writes, as he writes it. A new word appears on the screen the instant he says it . . . step by step a problem is solved before the eyes of the entire class as he explains it. Almost without effort the Vu Graph becomes his "right hand of teaching."

To learn about the specific benefits of Vu Graph Overhead Projectors for your school write for a free, "no obligation" demonstration . . . or "Vu Graph As An Instruction Aid," a free, informative booklet written for teachers by teachers.

CB PROJECTION DIVISION
CHARLES BESELER COMPANY
204 So 18th St East Orange, New Jersey

simple and should work effectively when it is properly adjusted and the vibration defect is corrected. Macalaster Bicknell Company, 253 Norfolk St., Cambridge 39, Mass.

Van de Graaff Generator. A good model, 17 inches high, of a commonly used static electricity generator. This one has an advantage in that both the aluminum top and bowl-shaped base can be lifted to show moveable parts. The insulating column between top and base are constructed of unbreakable vinyl plastic. The generator has a potential of 200,000 volts. Extra rubber belts are provided. The construction is simple and has been found satisfactory with repeated hard use. Meets specifications of NDEA-CCSSO Purchase Guide. \$39.50. Edmund Scientific Company, 101 East Gloucester Pike, Barrington, N. J.

Space Kit. A comprehensive kit which can contribute much to the study of satellites, their orbits and outer space. Contains maps, charts, guidebooks, and two space slide rules. The slide rules are plastic and well constructed. Directions for the kit are clear

"Cold Light" Luminescent Chemical Demonstration for Classroom use. Ideal for science fairs. Other science teaching aids available.

Write to—**VARNITON COMPANY**
416 N. Varney St. Burbank, Calif.

MICROBIOLOGY

Source Data Information on all phenomena. Mature single-purpose films presenting the most significant microbiological phenomena disclosed in living organisms by the Nobel winning Phase-Contrast method.

Write for descriptive folders

ARTHUR T. BRICE

PHASE FILMS

SONOMA, CALIFORNIA

except for the use of the satellite equatorial angle slide rule. Recommended for junior and senior high school. \$4.95. 20 per cent discount to schools. 1960. Space Research Distributors, Inc., 208 Commercial Building, Avon Lake, Ohio.

The Ripple Tank Kit, No. 2400. The ripple tank may be set up according to instructions contained in the kit and used to demonstrate experiments on wave phenomena in water, as described in the Laboratory Guide to the Physical Science Study Committee (D. C. Heath and Company, 1960). Equipment provided consists of an assembled tank, materials for constructing the wave generator, dampers, paraffin blocks, and a glass plate. The tank, made of aluminum (extrusion "picture frame") with a glass bottom, should be filled with water and allowed to stand for about twenty-four hours. Although no supports for the tank are included in the kit, four ring stands will serve the purpose. The wave generator consists of a small motor with an eccentric fly wheel, held to a wooden bar by a spring clothespin. The bar, suspended by two rubber bands from an overhead support, forms the plane wave generator. Point-source ripples are formed by inserting L-shaped metal rods in the bar and contracting the water with plastic balls ("pop pearls" will do) placed at either end of the rods. A small rheostat and wire are included. Wave frequency is variable over an adequate range, using a 1½-volt dry cell as a power source. Surfaces of the wooden parts are unfinished and should be waxed or varnished before use to prevent absorption of water. This reviewer found that the tank and wave generator operated satisfactorily when tested. Certain modifications might be made to suit individual preference, but the apparatus will perform, by following instructions, just as it is assembled from the kit. \$14.64. Macalaster Bicknell Company, 253 Norfolk St., Cambridge 39, Mass.

Index of Advertisers

American Optical Company	17-18
Ariel Davis Manufacturing Company	Cover III
Charles Beseler Company.....	65
Bronwill Scientific.....	66
Buck Engineering Company, Inc.....	56, 57
Cambosco Scientific Company, Inc.....	40
Chilton Books.....	41
Clay-Adams, Inc.....	48
Columbia University Press.....	37
Cooke, Troughton & Simms, Inc.....	62
Corning Glass Works.....	52-53
Coronet Films.....	58
Criterion Manufacturing Company.....	37
Denoyer-Geppert Company.....	26
Doerr Glass Company.....	36
E. P. Dutton & Company, Inc.....	64
The Ealing Corporation.....	47
Edmund Scientific Company.....	50
Electronic Organ Arts.....	5
Elgeet Optical Company, Inc.....	42
The Graf-Apsco Company.....	60
Harcourt, Brace & World, Inc.....	46
Harper & Brothers.....	31, 62
Heath Company.....	63
Indiana University.....	39
Laboratory Furniture Company, Inc.....	31
Medical Plastics Laboratory.....	65
Modern Learning Aids.....	43
Morris and Lee.....	63
The Nalge Company, Inc.....	1
Ohaus Scale Corporation.....	Cover IV
John F. Rider Publisher, Inc.....	60
Science Associates, Inc.	24
John E. Sjostrom Company, Inc.....	44
Sky Publishing Corporation.....	51
Swift Instruments, Inc.....	63
Teachers Practical Press.....	55
Teaching Materials Corporation.....	Cover II
Turner Corporation.....	61
Unitron Instrument Company.....	34-5, 58
Universal Scientific Company, Inc.....	59
Viewlex, Inc.....	45
The Welch Scientific Company.....	2
Wilkens-Anderson Company.....	64

Godfrey MOLECULAR MODEL KIT

Plus NEW SUPPLEMENTARY MODELS

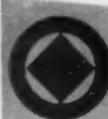
for Researchers,
Teachers, Students

Godfrey molecular models give best representation of van der Waals' and covalent radii—a true picture of steric hindrance. Models of small ring compounds and bicyclic compounds easily made. Show flexibility and resilience of actual molecules.



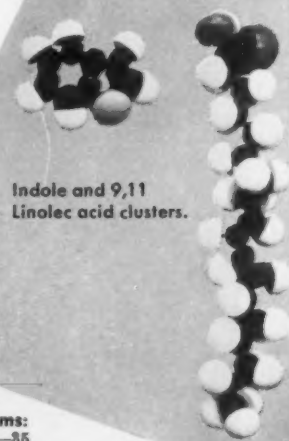
NEW Supplementary Atoms:
15 new atoms just designed—35 elements may be represented in 65 valence states, using only 26 different atoms.

Write for Full Details

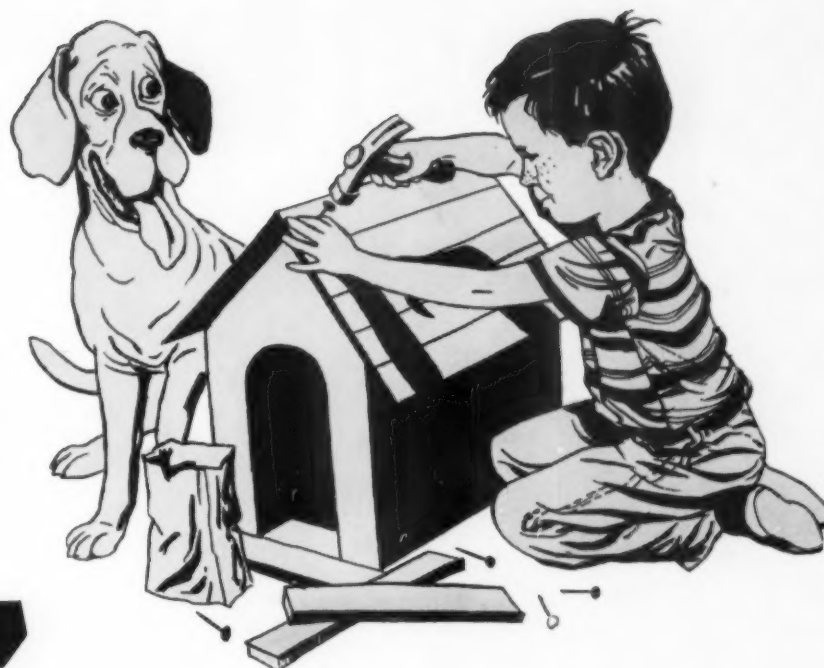
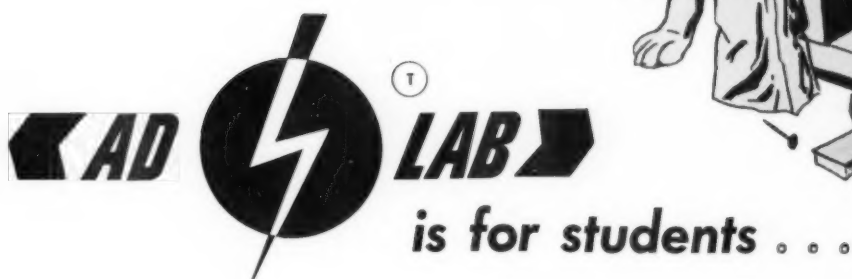


BRONWILL SCIENTIFIC
A Division of Will Corporation

278 N. Goodman Street
Rochester 3, New York



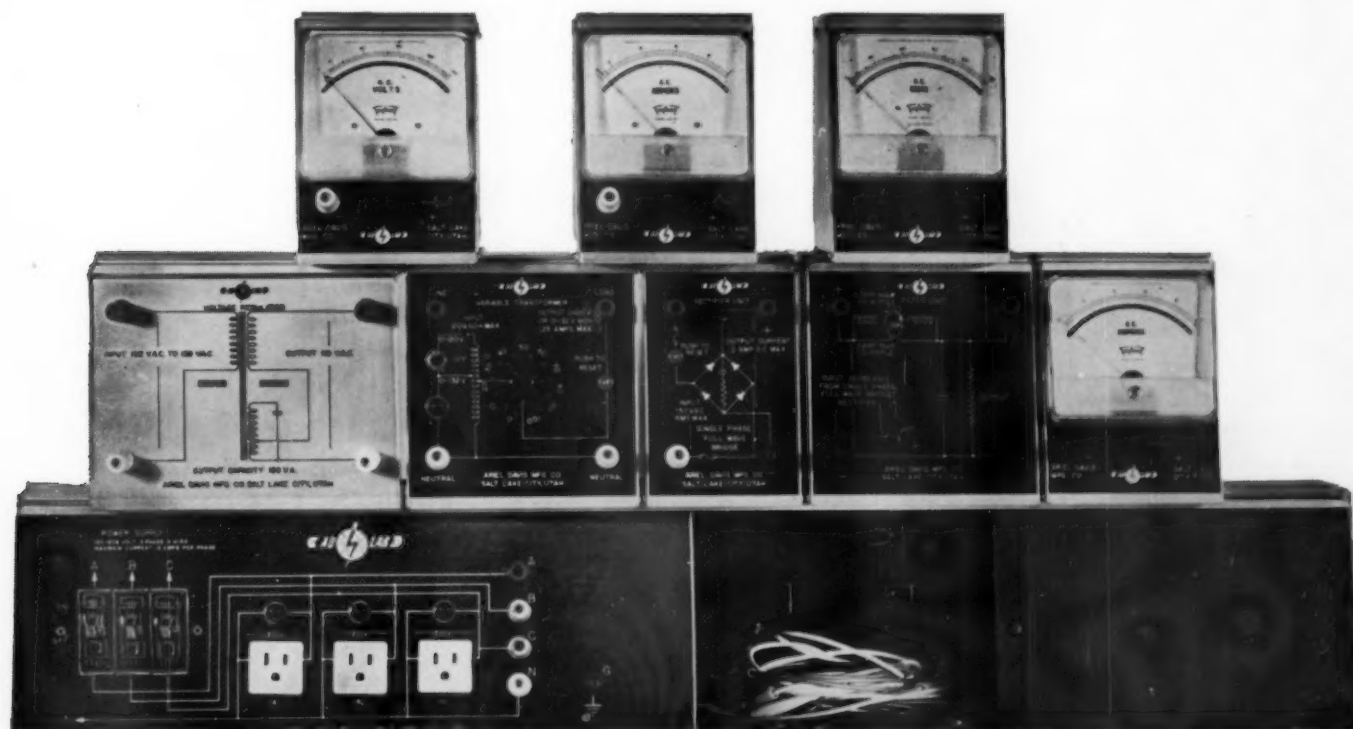
**Every student
learns more
by doing!**



With AD-LAB each student has the opportunity to prepare his own electrical system and learns by doing. Electrical schematic on the face of each component helps teach this vital information by constant repetition. The modular system makes it easy for students to learn the relationship between

the various electrical components. This teaches the student the fundamentals of electrical design, and demonstrates that even the most complex electrical equipment is nothing more than a series of simple electrical devices. For FREE AD-LAB folder write:

ARIEL DAVIS MANUFACTURING COMPANY Dept. H 561, 3687 South State Street, Salt Lake City, Utah .



NOW...TWO MODELS...TWO CAPACITIES...FITS EVERY NEED



CAPACITY 311 Gram
SENSITIVITY .01 Gram

THE POPULAR

Cent O Gram

An unbeatable balance for general laboratory weighings, specific gravity work, and preweighing, the CENT-O-GRAM is an accepted pace setter in its field.

As well as being portable, this balance is adaptable for use in many fields.

The 311 gram capacity is higher than any balance of its type through use of two 100 gram self stored attachment weights.

Comes equipped with stainless steel bows, pan (3-3/4" dia. x 1/2" deep) and specific gravity platform.



THE ALL NEW

Dec O Gram

This latest OHAUS overhead triple beam balance has a capacity of 2610 gram.

Such other familiar OHAUS features as sturdy box end beam, sliding type poise with center indicating panel, self aligning bearings, self storing attachment weights and specific gravity platform, all add up to fast sensitive high capacity performance.

Available in two models... the Model 3600 (metric) and Model 3601 (avoirdupois).



CAPACITY 2610 Gram
SENSITIVITY .05 Gram

OHAUS SCALE CORPORATION
1050 COMMERCE AVENUE UNION, NEW JERSEY